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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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VOL. X. NEW YORK, OCTOBER 22, 1887. No. 17.

IF there are not ten "anticipations" and a dozen improvements on Prof. Forbes' coulomb meter before the month is out, we shall be very much surprised.

THE sale of the Baltimore & Ohio telegraph has naturally called forth many stories and reminiscences, not the least interesting of which is that connected with Ezra Cornell and his work in "pipe laying" along the railroad for Professor Morse's telegraph. As we all know, the wires were soon removed to poles, the piped wires being a failure, but out of that failure grew Cornell's fortune and the university that bears his name.

THE question has often arisen, though indeterminately, as to the value of the exclusive lighting franchises granted by not a few towns and cities in different parts of the country. In our columns this week will be found an important decision on the subject, from Grand Rapids, Mich. The matter has not, it is believed, ever been thoroughly handled in the courts before, and the judgment is, therefore, one worthy of special note. The peculiarity in this case is that the city council after granting an exclusive franchise proceeded to pass another permissive ordinance, and out of this came the suit.

IN one or two quarters there has been some disposition shown to chuckle over the remark of Prof. Wiesner, of Vienna, to the effect that electric light in libraries is very favorable to the discoloration of paper in the books there. He, therefore, is said to urge gas light. If this be all true, electricians are quite willing to accept the dictum, seeing that the Professor classes the electric light with sunlight, and is, after all, only making observations on the discoloration of wood pulp paper. Moreover, so far as we can discover, the criticism is aimed at the arc light, and for ourselves we may say that on all grounds preference in such a place is to be given to the incandescent light. Where incandescents are used not the slightest ill effect of any nature whatsoever is to be apprehended or has ever been detected.

THIS day is the twentieth anniversary of the organization of the Telegraphers' Mutual Benefit Association. On Oct. 22, 1867, at a meeting held in the old 145 Broadway office of the Western Union Company, the association was organized under the name of "The Telegraphers' Mutual Life Insurance Association," which a few years later was shortened to the present title. From the original membership of 125 the association has steadily grown to a membership at this date of over 3,200. It is to-day—with one unimportant exception—the oldest assessment insurance association in the United States, while its reserve fund and conservative methods render it second to none in stability. Since its organization it has paid over $311,000 to the beneficiaries of telegraphers. The twentieth year, just ending, has been one of the most successful in the history of the society, and the outlook for the future has never been brighter. The old-time telegraphers who organized the association, foremost among whom was Mr. James D. Reid, may well be proud of the outcome of their work.

THE annual report of the Western Union Company, to be found in another column, is an imposing array of figures, and yet next year's report, to comprise the statistics of the system recently acquired, must of necessity eclipse it. Such an aggregation of capital, offices, wires and employés is gigantic, and might well be regarded as the penultimate or final stage in telegraphic absorption and monopoly, beyond which there can lie only the transfer of the system to the hands of the government. We notice that this view of the case has greatly impressed many of the newspapers, and that the cry for governmental control has been revived more loudly and vigorously than ever. But, as we have before pointed out, with the telegraph must go the telephone. If the government acquires one it must take the other, and both at their earning capacity. Now, is the country prepared for this? The little purchase would certainly be one very effective way of wiping out the present surplus in the Treasury, and thus would help settle a number of other weighty problems. In fact, it is not impossible that the purchase may become a leading issue in the Presidential campaign next year. On the other hand, should the purchase not take place, we see nothing to prevent a closer alliance between the telegraph and telephone systems of the country, but a great number of reasons why the two should be worked together harmoniously. Just how this will come about it is hard to say. It may not happen, but it is among the things that are probable, and certainly among the things, we venture to assert, that have been discussed.

LAST week, commenting on the condition of the operators "thrown out" by the recent telegraph consolidation, we alluded to the argument that has been drawn from their unhappy position in support of a government system which would give them permanent tenure of office, under civil service rules. This is an argument of great force and validity, but it is not to be forgotten that the telegraphers in England, all under government, have generally some grievance about which they are petitioning; and the latest English journals to hand state that a big meeting of the male staff in London, to discuss a variety of ills and wrongs, is shortly to be held. Still, the position under government in America would, perhaps, not be so irksome and hopeless as it often is in Europe, where a man in such an employ soon becomes pledged to it for life, the severity of competition pressing him back into it whenever he seeks to make a new start later. Here, in a country whose name, as Erastus Wiman puts it, means opportunity, the situation and the prospect would at all times be rosier, and the restless, discontented spirits would be drawn off by the natural development of commerce and industry. Even if a man gets down in America, he can rise again, provided his nature is resilient, and hence he is the more ready to take chances that in Europe it would almost be criminal for any one with a family to support to look at. Most of the men in high telegraphic positions in this country to-day have risked a good deal. There are instances, now fresh, in which such men have "been left," but nobody thinks worse of them for the venture.

WE describe this week the first electric mine railway in America, and, fittingly, the longest of its kind in the world. Considering the ease with which the electric railway can be applied, especially in coal mines, where the item of fuel cost does not enter into the problem, it is somewhat strange that no work of this character has been done before. But the results obtained in the first attempts leave little doubt that it is now only a question of time when every large coal mine at least will have its electric road. On a recent visit which we made to the great Lykens Valley mines we had an opportunity of witnessing this road in operation, and its performance was, we are free to state, a most satisfactory one. A direct proof of this can be found in the fact that since our visit the road has been extended a distance of a quarter of a mile. In all probability a similar road will be placed in the lower drifts. The great benefit derived from the use of electric locomotives in the mine lies not only in the convenience and cheapness as compared with mule power, but in the great improvement in the atmosphere of the mine, which is no longer laden with the products of the locomotive furnace. The remarkable ease with which the apparatus can be handled, and the absence of skilled labor, at once stamp the electric locomotive as the one of the future for mines.

OUR excellent gas contemporary, the *Progressive Age*, has a timely note on the rapid advance of electrical science, especially in the field of the application of electricity to lighting, and it says appreciatively: "The energy which is displayed by those foremost in the management of electric lighting industries is destined to place the electric light on a safe and sure footing in all sections of the civilized globe." It expresses the opinion, also, that the business is, as a rule, carried on "in the most legitimate manner." At the same time it does not discover that the electric light has diminished at all the output of illuminating gas. Probably not. The eye has been keyed or educated up to a standard where more light is habitually wanted, and hence there has been a greater consumption of gas. Streets lit by gas look terribly dim and sombre near streets lit by electricity, and the man who steps indoors from the cheerful light of the arc is apt to turn on his gas burners pretty well to the full. But where there is a difference, we think, is in the price of gas. We have looked into this subject a little and find that in a number of places where the electric light has been introduced, the average reduction in the price of gas has not been less than 25 per cent. On the greater consumption, the gas company can endure this without loss, and thus it may be claimed, without injustice, that the benefit done by electricity to the gas consumer has been arrived at in a normal manner, and that the sad ruin brought so often on old industries by new and improved methods has in this case been avoided. The shrewder heads among the gas companies see this, and live up to their convictions. Meantime the incandescent light is gaining in favor at a rapid rate, and as it does so a new set of conditions arise. For this coming state of affairs many gas companies, by entering upon the electric light business in a variety of ways, have prepared themselves.

THE paper read by Professor Forbes before the American Institute of Electrical Engineers and the discussion thereon, brings out strongly the question of the best form for electric meters, a matter which has lately been given additional interest by the introduction of the alternate current system of distribution. It was, indeed, the latter which may be said to have been the direct cause of the production of the instrument by Professor Forbes, and we believe, from the results obtained, that the principle employed is the one which will be largely resorted to in the future in alternating plants as well as others. The numerous objections raised against the instrument during the discussion were all satisfactorily combatted and explained away by the inventor. Of these the most important seem to us the ones raised against the instrument regarding its apparent delicacy. It has to be considered that an instrument of this nature must of necessity be capable of withstanding rough usage. We are glad to learn, therefore, that modifications are already contemplated which will meet this point. The table showing speed and current also proves the instrument to be very constant over a considerable range. What must be noted as to a certain extent anomalous is the fact that, according to Prof. Forbes, the instrument, though originally designed with due regard to theory, in nearly every detail necessitated the abandonment of theory and called for empiricism. Probably Professor Forbes did not intend to imply the full meaning which his remarks on this head may be given by some, for it is evident that while the theory involved in the principal actions within the instrument is well known, we have here a special case, including factors that make actual practice vary greatly from what theory would predicate. This, however, does not vitiate the theory, but merely circumscribes its limits, and the instrument in this respect resembles others which might be mentioned.

NEW BOOKS.

HANDBOOK OF ELECTRICAL TESTING. By H. R. Kempe. Fourth Edition. London and New York E. & F. N. Spon. 551 pages, $5.

Kempe's handbook is so well known that we need not enter into any description of its contents. We would only draw attention to the fact that its usefulness has been still further increased by new matter and the revision of the old. In its present form it is undoubtedly the most complete compendium of its kind to be found in any language.

ELEMENTARY TEXT-BOOK OF PHYSICS. By Prof. William A. Anthony and Prof. Cyrus F. Brackett. Third edition, revised and enlarged. New York: John Wiley & Sons, 1887. 527 pages; price, $3.

With the additions made by the authors in the present volume, there is presented a most complete exposé of what may be called the philosophy of physics. Their aim has been to explain the principles underlying the science. Taken in connection with a course of lectures in which these principles are demonstrated by means of apparatus, it offers a valuable means of fixing in the mind of the student those laws which are the foundation of applied science.

Meeting of the American Institute of Electrical Engineers.

On Tuesday evening, Oct. 11, at the monthly meeting of the American Institute of Electrical Engineers, Prof. George Forbes, F. R. S., read a paper on the coulomb meter. The paper in full and the discussion will be found elsewhere in our columns. The regular business was followed by a collation and a reception to Professor Forbes, in which nearly 100 gentlemen took part, including Messrs. Edward Weston, Frank Pope, C. Batchelor, G. G. Ward, F. W. Jones, J. D. Reid, G. D'Infreville, George Hamilton, Dr. Vander Weyde, J. M. Pendleton, Lieut. J. Millis, R. W. Pope, S. S. Wheeler, J. Hamblet, J. W. Howell, E. E. Ries, S. F. Shelbourne, C. O. Mailloux, M. Holroyd Smith, A. G. Holcomb, E. R. Knowles, F. Benedict Herzog, H. Howson, Townsend Wolcott, J. Wetzler, G. M. Phelps, Jr., E. P. Thompson, F. B. Crocker, W. Forman Collins, C. Cuttriss, M. M. Davis, A. E. Braddell, C A. Terry, W. A. Giles, Gerrit Smith, C. L. Healy, C. G. Curtis, C. J. Field, G. F. Sandt, John Bogart. The occasion was of the most pleasant and interesting character.

The Western Union Annual Report.

At the annual meeting of the Western Union Company on Oct. 12, it was voted to increase the capital stock by $5,000,000 to pay for the Baltimore & Ohio telegraph property. This is the list of the directors elected: Norvin Green, Thomas T. Eckert, John T. Terry, John Van Orden, Jay Gould, Russell Sage, Alonzo B. Cornell, Sidney Dillon, Samuel Sloan, George J. Gould, Edwin Gould, John G. Moore, Cyrus W. Field, Henry Weaver, Percy R. Pyne, Charles Lanier, Austin Corbin, J. Pierpont Morgan, Frederick L. Ames, John Hay, William D. Bishop, C. P. Huntington, George B. Roberts, Sidney Shepard, Erastus Wiman, John J. Astor, Chauncey M. Depew, James W. Clendenin, Abraham B. Van Nest, Robert C. Clowry.

The annual report of President Green showed the outstanding capital stock to be $81,199,852.06, of which $21,282 belonged to and was held in the treasury. The stock had been increased to the extent of $1,200,000 during the year for the special purpose of taking up the dividend scrip of April, 1886. The bonded indebtedness, less the sinking fund, was reported to be $6,732,420.96.

In referring to the business of the last year the following statement was made:

Surplus July 1, 1886		$4,309,833.53
The revenues, expenses and profits of the year ended June 30, 1887, were as follows:		
Revenues	$17,191,909.95	
Expenses	13,154,628.54	
Profits		$4,037,281.31
		$8,347,114.94
From which there was applied:		
For dividends	$811,864.43	
For interest on bonds	493,074.40	
For sinking funds appropriations	39,991.00	
		$1,344,929.83
Deducting which, leaves surplus June 30, 1887, of		$7,002,185.11
The expenses for the year were:		
For operating and general expenses		$9,077,445.42
For rentals of leased lines		1,899,953.74
For maintenance and reconstruction		1,673,670.11
For taxes		278,594.44
For equipment of offices and wires		224,964.83
Total expenses as above		$13,154,628.54

The increase of messages handled during the year over the previous year was 4,104,723—the largest increase ever made by the company, except in 1881, when the American Union and Atlantic and Pacific companies were taken in. The report further states that every message carried at 10 cents or 15 cents is carried at an actual loss.

The report further says: The construction account has been unusually large, because of the great extensions of new and branch railroads, compelling extensions of telegraph lines on new routes and into new territory. The demand for private wires has also compelled the erection of additional wires on trunk lines. The number of messages handled shows a larger percentage of increase in traffic than in any one year since 1881, which, with the increased exactions of prompt service, involved the necessity of erecting additional wires on all the principal trunk routes. Considering the amount of business that must have been done by other companies, there can be no business in the country that has developed,

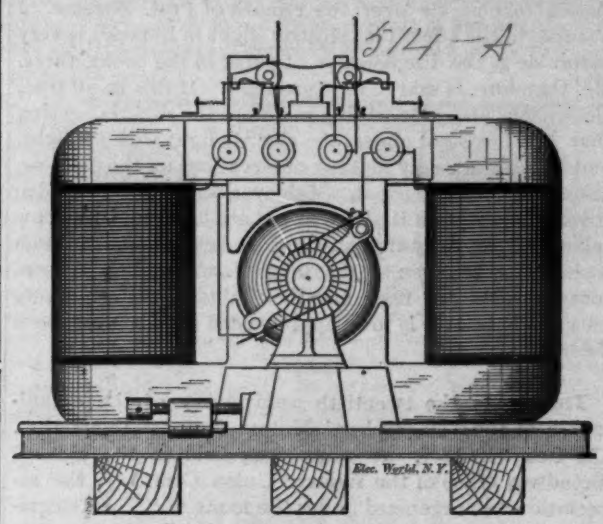

FIG. 1.—GENERATOR, SCHLESINGER ELECTRIC MINE RAILWAY.

and is developing, such rapid growth and increase as the service of the telegraph.

Of the press service the report says: About 92 per cent. of our toll revenues are derived from commercial and family and social messages, and 8 per cent. from the press. The news service delivered by this company's wires during the year—counting one delivery at each place served—foots up some 740,000,000 words, of which 578,000,000 words were for the various press associations and 162,000,000 words were special reports for individual newspapers.

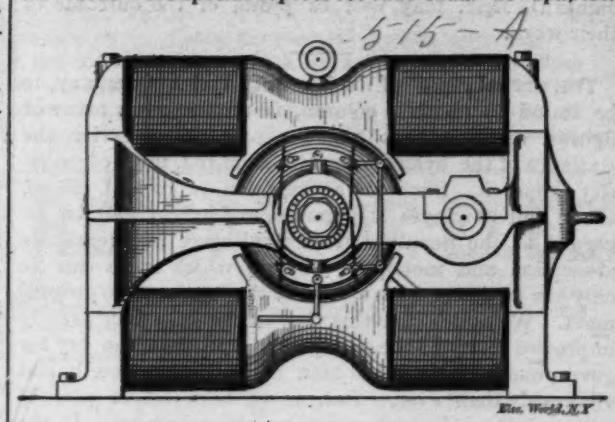

FIG. 2.—MOTOR, SCHLESINGER RAILWAY—ELEVATION.

The 578,000,000 words for press associations were delivered to and published by an average of 2¼ newspapers at each place they were taken off, which added to the special reports would made some 1,467,000,000 words of press report received and published by the various newspapers throughout the country over the wires of this company during the year.

Only one allusion was made to the purchase of the Baltimore & Ohio telegraph system, and that was in the following words: "The facilities and advantages afforded

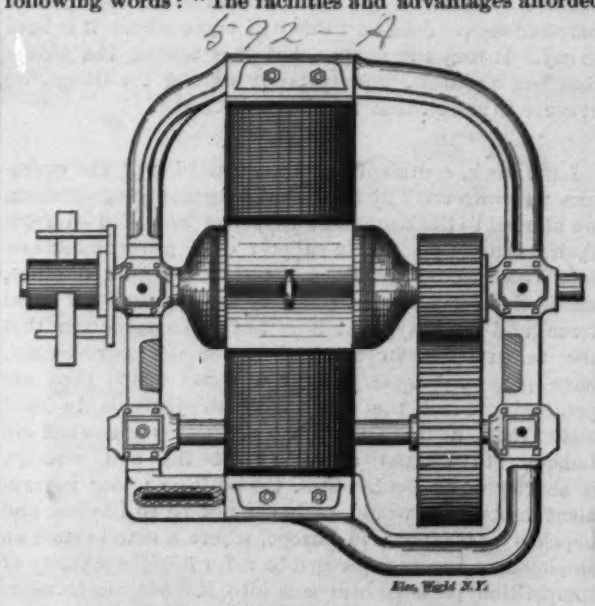

FIG. 3.—MOTOR, SCHLESINGER RAILWAY—PLAN.

by the addition of Baltimore & Ohio system, it is confidently believed, will largely increase the revenues. This acquisition and others made since the close of the fiscal year, and not included in any of the figures of this report, will swell the company's plant to about 162,000 miles of lines and over 580,000 miles of wires." It is significant that no mention is made in the report of the big scheme to issue stock for the guaranteed securities.

The Schlesinger Electric Railroad in the Lykens Valley Coal Mine.

The electric railroad in the Lykens Valley collieries was built for the purpose of hauling the coal mined in the upper part of the workings out of the mine. It is the first and only electric mine railroad built in America, and exceeds, as regards power and length, any of those built in Europe. The following table shows the relations between the different roads:

Where running.	System.	Length.	Speed.	Weight of locomotive.	Largest weight pulled.
		Feet.	Miles.	Lbs.	Tons.
Zankeroda	Siemens and Halske	2,028	6	3,520	13½
Paulus and Hohenzollern	Siemens and Halske	2,460	.....	4,200	.....
Lykens Valley	Schlesinger	6,300	6	15,000	100

The plant in Lykens was put in operation on the 26th of July, 1887, the steam connection and governor having been completed on July 23, and has been working without trouble ever since, hauling with ease trains of from 10 to 21 cars, weighing from 50 to 100 tons, according to whether loaded with coal or rock. As soon as the gangway is completed and the works are opened up, the motor is to haul from 200 to 250 cars a day, or bring out from 900 to 1,125 tons of coal. The trains are hauled out at a speed of 6 miles an hour (the maximum speed allowed in the mines), making the round trip, with necessary stoppages at the termini for shifting, in from 25 to 30 minutes, whereas it took the mules three times as long. On several occasions the motor has already hauled trains out at a speed of 10 miles an hour, and once even as fast as 15 miles an hour.

Outside of its greater economy, the electric mine locomotive has other great advantages over the steam locomotive and over mules; its greatest feature is the entire absence of smoke, steam and sulphur, and the non-consumption of oxygen. How important, especially the first-named feature is, only those who have been in gangways in which steam motors are running can fully understand; and it is due to this also that the electric motor can be put in places where the steam engine could not be used, for the latter, on account of the unhealthy gases, etc., it gives out, is limited to places near the fans, so that these gases are at once removed from the mine, as it is dangerous to allow the air, after once having passed through the steam locomotive, to go to places where men are at work. With electric motors this precaution is unnecessary.

As regards the non-consumption of oxygen by the electric motor, it saves in the drift at Lykens 20,000 cubic feet of air per minute, which would be required for a steam locomotive. But outside of this, another great advantage of the electric locomotive lies in the fact of its having but few working parts, and that these can be got at with the greatest ease.

The plant in Lykens was built by the Union Electric Co., of Philadelphia, the Schlesinger system and machines being used. The drift in which the motor runs is one of the upper drifts of the Lykens Valley collieries, the entrance to it being on the side of a mountain. Like all gangways it is higher at its further or inside end, but the average grade is below that usually employed, being only 3 feet in 100, 5 feet in 100 being the usual grade. In most places the road is perfectly level; there are three or four down grades, two of which are very heavy, and two reverse grades, one being 1½ per cent., up which the loaded cars have to be hauled. The road outside the mouth of the drift is about 300 feet long, and enters the mountain on a curve having 105 feet radius. For 1,500 feet the road is practically straight, then comes an S curve, with a 90 feet radius, and a series of smaller curves up to 2,400 feet from the entrance; the next one-half mile is nearly straight, but at the end of it is a 90 degree curve, having a 30 foot radius, and 200 feet further is another 90 degree curve, with less than 25 feet radius.

The siding down which the empty cars are taken at present so as to be out of the way of the loaded train (or trip) is between these two curves. In a short time the gangway leading to the regular turnout, which is about 1,000 feet further in, will be completed, and the above-mentioned siding will be abandoned. In coming in with the empty cars the motor finds the loaded ones generally standing distributed on the curves and between them. The motor has to collect them and then to push them up a 1 per cent. grade and round the 25-foot curve, until the siding for the empty cars is cleared. This is the heaviest work the motor has to perform, especially when the cars are loaded with rock. The start from the inside is always made while the train is standing on one or the other, or, if a long train, on both these curves. The gangway is so low in some places that it is impossible to walk upright.

The cars in use weigh empty 3,300 lbs., and have a capacity of 94 cubic feet each. The wheels are 18 inches in diameter and run loosly on the axles, like ordinary wagon wheels; the axles are rigidly attached to the car body. The result is that very soon the hole in the wheel through which the axle passes, is worn larger, and unless carefully and frequently oiled the cars run very heavy, especially as the wheels are often worn oval or flat, due to the insertion of sprags to prevent the cars from running away

down hill to and stop them when mule power is used. The largest work performed by the motors so far was, at one time to push a train of 12 cars loaded with rock and weighing about 150,000 pounds up grade round the 25-foot curve; another time a train of twenty cars was started on this curve, only three cars and the motor standing on or beyond it, the other 17 cars standing at right angles to the direction in which the motor was pulling.

A 25 pound iron rail is used as the conductor, which is fastened to props inclined a little from the vertical, as they were easier to put up in that position. About half way between the top and bottom of the props, and mostly at a height of 22 inches above the track and 15 inches to the side, blocks are fastened, and to these are screwed the rails, which are insulated by rubber. In places where men or mules have to cross the conductor, it is raised to a height of 5 feet 9 inches, and recedes to 24 inches from the track, the ascents and descents being made gradual. Outside the drift the conductor is 5 feet 9 inches high all along. The props are placed 10 inches apart on the lower side of the gangway, so as to be out of the way of the miners, although the E. M. F. used (350 to 400 volts) is not dangerous. As an instance, several miners have already accidentally, or purposely, touched the conductor and received shocks from the same, which had no other effect than for the instant to paralyze their legs and thus throw them down, without in the least injuring them. In not one single instance was any one of these miners prevented from resuming work at once, nor did they feel any after effects from the shock. The joints in the rails are all carefully made by placing brass plates under the fish plates and bolting these down tight, so as to press the brass into all the uneven parts of the iron rails. The track rails are used as the return conductor, and these are connected together in the same way as the conductor. At a distance of every 100 yards the two track rails are connected by heavy copper wire, so that repairs can be made to the roads while the motor is inside without interrupting the current.

The engine-house is situated at the mouth of the drift on the side of the mountain. The steam engine used is an old one which has been in use in the mines for more than 25 years. It is an old style, long stroke, and was formerly used for hoisting purposes. Since it was built it has undergone a good many changes, so that at present the steam ports are entirely out of proportion to the size of the cylinder. This engine will most likely be soon replaced by another. The steam is conveyed to it from boilers 1,000 feet away, and a great saving in power might have been effected had the engine room been placed nearer the boilers; but as a steam pipe passed near the present location of the engine room it was thought cheapest to place the latter near the entrance of the drift.

The engine is run at a speed of 60 revolutions, and from a 9 foot band wheel the power is transmitted by a 10 inch belt to a countershaft, from which the power is transmitted to the generator. This latter, shown in Fig. 1, is a 50 h. p. series wound dynamo of the Manchester type. The armature is of the drum type, 12 inches in diameter, and makes 700 revolutions per minute. The commutator is placed outside the bearings and has 32 segments.

The cores of the field magnets are forged out of picked scrap, the pole pieces being of cast iron. The whole machine weighs 1¼ tons, and takes up a space of about 3½ × 5½ feet, and is 2½ feet high. A safety cut-out is placed on the dynamo, which puts a large resistance into the circuit whenever the current exceeds a fixed limit, thus reducing it and preventing the destruction of both generator as well as motor armature. A large gong in the engine room rings whenever this safety device acts, and until it is reset. The generator is at present in charge of a boy 18 years old, who also acts as conductor to the train. The dynamo has been built with special regard to efficiency and simplicity, its main feature being that the commutator can be replaced by an ordinary mechanic without testing instruments within one hour and without a possibility of a mistake being made.

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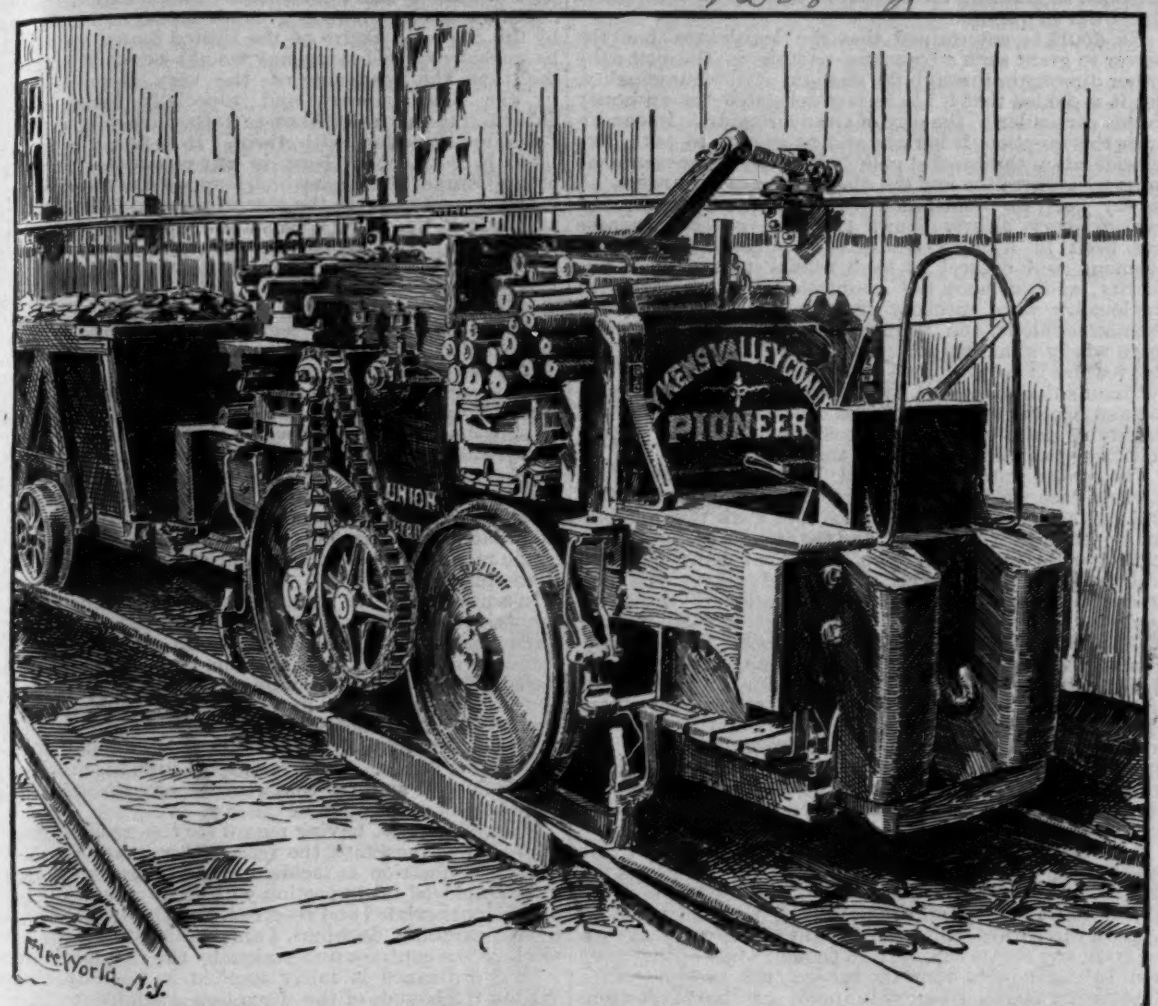

FIG. 4.—LOCOMOTIVE ON THE SCHLESINGER ELECTRIC ROAD, LYKENS VALLEY MINE, PA.

The motor, shown in elevation and plan in Figs. 2 and 3, has been specially designed for railroad work. The field-magnet consists of three parts, viz., the magnet proper and a frame, part of which forms the yokes of the magnets. In this frame are cast the two bearings of the armature, and parallel with these are two others, which support a countershaft, which thus forms part of the motor, This method prevents any binding in the gears, as it is impossible for the shafts to get out of parallel. The cores of the magnets are of cast iron. The armature is of the drum type, 9 inches in diameter, and carries a pinion wheel at one end. The commutator is outside the bearings, and has 32 segments. Four brushes are used, fastened to rocking arms; two for the forward and two for the backward motion. The weight of the motor, with countershaft and gear, is 1,500 pounds.

The speed of the armature is 1,050 revolutions per minute when the cars are running at six miles an hour; that of the countershaft is 420. All the bearings are provided with oil cups, and to guard against delays while running, through heating, large grease boxes are provided. The countershaft carries a spur wheel, from which the power is transmitted by an endless chain to a second countershaft, and with this latter both car axles are connected by chains.

The motor, like the generator, is series wound. It is securely fastened by eight bolts to a strong wooden truck having 30-inch wheels and a wheel base of 40 × 40 inches. The truck is built for a weight of 15 tons. The motor is entirely boxed in, one of the countershaft bearings and the spur wheel passing through one end of the box, while at the other end is a door through which the commutator can be reached and the brushes set. The top of the box is also removable. On either side are large compartments, well braced, for the placing of ballast. This consisted at first of scrap iron, as shown in the engraving, Fig. 4, but now iron plates, 2 inches thick, specially cast for the purpose, have been put on. The seat for the driver is at one end and placed sideways, so that he can run the locomotive either way without having to change his seat. With his left hand he operates a powerful hand-brake and with the right the regulating lever. At first the regulation was effected by two levers, one to reverse the motor and one to start, regulate the speed and stop the motor; but now both these actions are performed by one lever. By moving it out of its central position away from the driver, the motor is run forward; by moving it toward the driver, it is reversed. The speed is regulated with the same lever by means of resistance coils placed in an open box underneath the foot-rest for the driver.

The necessity for simple means of operating the car is obvious, when it is considered that the motor runs in a dark tunnel with a large number of sharp turns, and the walls or sides of which are liable to give way at any moment, and the circumstances being such that a breakdown of this nature is generally not recognizable until the motor is within but a few feet of the place. An electric lamp was attached in front of the driver, to act as a current indicator, but although it simply hung in the wires, the jar of the car was so great that several lamps were broken in a very short time. A plain ammeter consisting of a solenoid with a long pointer now takes its place. The motor, with ballast, weighs about 7½ to 8 tons.

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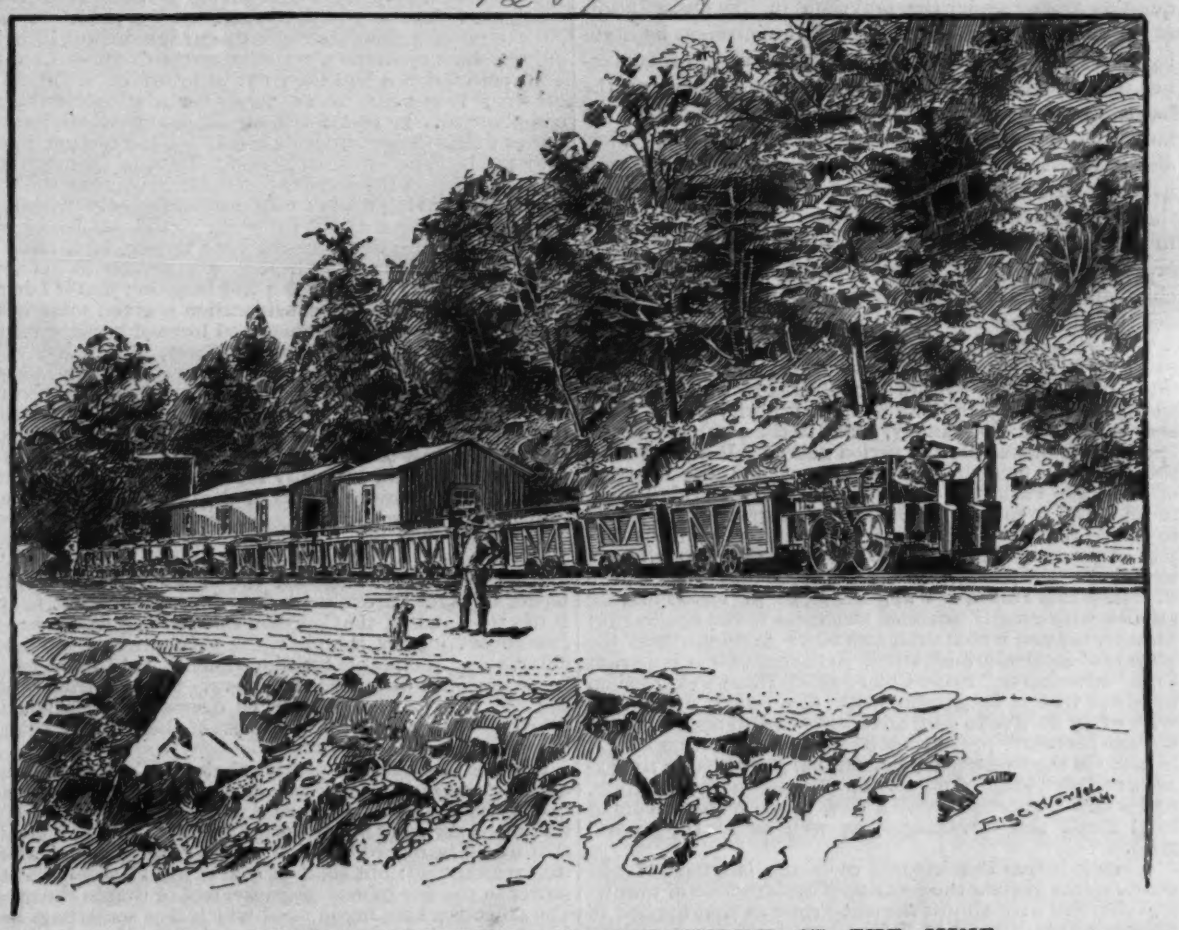


FIG. 5.—VIEW OF TRAIN AT THE MOUTH OF THE MINE.

The current collector, as shown in Fig. 4, consists of a frame having two vertical and two horizontal wheels. In this frame is attached a rod which passes through a tube. The collector is pressed against the conductor rail by means of a strong spiral spring. The tube is fastened to a movable arm 4 feet long attached to a locomotive. This arm allows the collector to adapt itself to all vertical in

equalities of the rail, while the tube, spiral spring and rod take up all horizontal variations of the rail. This collector is connected directly to the switch box, and the return current passes partly through the chains and partly through small shoes rubbing against the car wheel, then through the latter and from them to the track rails. In addition to this, to prevent sand and dirt on the track interfering with the running, metal brushes are added, which either run continually on the rails or can be pressed against them by hand.

The chain transmitting the power from the first to the second countershaft has been especially designed for the purpose. The links are made of phosphor bronze and the pins of steel, the latter having a wearing surface of two square inches. From the second countershaft to the car axles, steel chains with thimbles are used. The introduction of so many countershafts, of course, reduces the efficiency of the motor, but it was unavoidable at the time; it is intended, however, to alter this soon.

The engraving, Fig. 5, is made from a photograph recently taken, and represents the motor hauling twenty loaded cars and one passenger car containing six persons.

The Exclusive Lighting Franchise at Grand Rapids, Mich.

An important action has just been decided at Grand Rapids, Mich., in the United States Circuit Court for the Western District of Michigan, Southern Division, in which an injunction has been granted in favor of the Grand Rapids Electric Light and Power Company against the Grand Rapids Edison Electric Light and Fuel Company. It appears that in 1880 the former company was granted an exclusive franchise for the supply of electric light and power in Grand Rapids, on certain conditions, for a term of fifteen years, and filed a bond of $20,000 for the guarantee of its faithful performance of the contract. It thereupon went to work, expended the sum of $120,000, built its station, ran nearly 50 miles of circuit, and has furnished 110 arcs to the city, 87 to other consumers, and about 250 incandescents, "and has in all things complied with the contract."

In May last, however, the Edison Company applied to the Grand Rapids Council for privileges and obtained an ordinance similar to that granted the complainant, except that it was not exclusive, and at once proceeded to carry out extensive plans in the way of erecting a station and constructing circuits. Suit was therefore brought by the older company on the ground that the second ordinance was in derogation of the rights granted to it by the ordinance of 1880 and injurious to its interests, and it asked for an injunction. The Edison Company interposed a general demurrer for want of equity, and rested the fate of the motion on the allegations of fact, admitting them to be true. The case thus presented involved the question arising under the provision in the Constitution of the United States prohibiting the impairment by State legislation of the obligation of contracts; and in this manner the controversy fell within the jurisdiction of the federal courts, it being a settled principle that not only the impairment by the constitution or laws of a State, but also such as is caused by the passage of municipal ordinances under color of authority from the Legislature of the State, is within the scope of the inhibition. The court in this case thereupon proceeded to consider whether the ordinance of 1880 did actually grant an exclusive franchise, and found that such was undoubtedly the fact. The decision thus goes on:

This brings the discussion to the other and more difficult question in the case, which is, whether, under the proper interpretation of its powers as conferred by the charter of the city, the Common Council had authority to do what they intended to do, namely, grant to the complainant an exclusive franchise for the period named. It is insisted by the defendant company that it had not, and the doctrine of the Hyde Park case and the Charles River bridge case, in reference to monopoly and franchise grants, is invoked to show that the silence of the charter upon the subject of granting exclusive privileges by the Council is a negation of the power. But it is obvious that in the nature of things this rule is not applicable, or at least must be applied with greatly qualified strictness to the language of State legislation which delegates to its municipalities the powers of local administration. In the one case it is a grant to an "adventurer," to use Chief Justice Taney's expression, or to one who is bargaining with the public authorities with every motive to gain advantage and to resort to the devices necessary to compass it, while in the other case it is made in the exercise of a discretion employed in the expedient distribution of public authority and administration, and which is exercised with a view to the requirements of local needs and advantages, as well as for the general good.

While it is true that in some cases the language of the courts seems to state the doctrine of construction of municipal charters with almost the same rigor as that applied to private grants, and to be imbued with the same spirit of hostility, still it is manifest that a general recognition of the nature and purposes of our municipal charters as a necessary and convenient part of government has led to the adoption of a more moderate doctrine, and without detailing the decisions of the courts it appears to me that Judge Dillon correctly states the results of them, and the true and reasonable doctrine as now held, when he says, in concluding his note to § 91 Municpal Corp., pp. 118-119, 3d Ed., "The principle of strict construction should not be pressed in any case to such an unreasonable extent as to defeat the legislative purpose fairly appearing upon the entire charter or enactment. Perhaps the rule as it is briefly expressed in the text best embodies the result of the adjudications upon this point, namely, if, upon the whole, there be fair, reasonable and substantial doubt whether the legislature intended to confer the authority in question, particularly if it relates to a matter extra-municipal or unusual in its nature, and the exercise of which will be attended with taxes, tolls, assessments or burdens upon the inhabitants, or oppress them, or abridge natural or common rights, or divest them of their property, the doubt should be resolved in favor of the citizen and against the municipality." The question, therefore, on this branch of the case is whether "on the whole" the Legislature is to be deemed to have intended in granting the charter to the city to vest it with the power in question.

No doubt is entertained that the legislature has the power to grant such a franchise as this to the company either directly or through the medium of the municipality, but it is denied that it has in fact delegated its authority in this particular to the city of Grand Rapids. In considering this question, it is right and necessary to take into consideration the general policy of our State government in its administration and the distribution of its powers. A survey of its legislation in respect to its municipalities very clearly shows that the general purpose has been in a marked degree to confide the management and control of local affairs to the local authority, and this upon the assumption that the people of the locality were specially interested in what concerned themselves alone, and were in a situation to determine more wisely what was expedient in such matters. While this feature is not of course peculiar to this State, it has yet been a dominant one. It has been recognized and commented upon in several decisions of the Supreme Court of the State, and generally its disposition has been to sustain and carry out that policy in an ample way.

The case of Putnam vs. Grand Rapids, 58 Mich., 416, is a recent case of this character. See also Attorney General vs. Detroit, 29 Mich., 198; Board of Park Commissioners vs. Detroit, 28 Mich., 288, and the opinion of the judges in People vs. Hurlbut, 24 Mich., 44. That court has several times on this general ground refused to entertain proceedings instituted by the representative of the State involving the interests of municipalities merely, and which did not concern the public at large. The Attorney General vs. Detroit, 55 Mich., 181, is one of such cases. It would be out of the ordinary course for the State to undertake to provide in what manner the city should obtain light. It would be difficult to understand upon what ground the State would care to reserve to itself the right to grant a franchise for this purpose, and to declare whether such franchise should be exclusive or not. A prime reason for this is that the State has no special concern with the subject.

It is not doubted that under the authority to provide light for the city and to control the use of the streets the Common Council has the power to license the use of the streets for putting up and maintaining the constructions necessary to furnish this kind of light and to contract with the company for its supply, and though some of the cases seem to cast a doubt upon the subject, the preponderance of authority seems strongly in favor of the proposition that the city may contract for such supply for a term of years, if there be nothing in the charter to prevent. If in the power to provide for lighting the city and to control the streets is implied the authority to license the company to use the streets for erecting and maintaining the poles and wires and to contract with it to supply light for a term of years, it is difficult to see why it has not power to grant this exclusive franchise for such a term upon the undertaking of the company to provide the supply upon reasonable terms. Who could complain? The service to be rendered is a public service. No one has any absolute right to engage in it. It could only be done upon the permission of the Common Council. That permission it had the right to grant or withhold to others, if it had contracted simply for a supply from the complainant. It seems trifling to say that an implied power exists to accomplish a result by indirection which may not be done by direct action. True, it is sometimes said, and this in the decisions of the courts, that the city may, after having made a contract confessedly within its power, conclude that its interests would be better subserved by paying the damages for a breach of it than by carrying it out, and is thus in a situation to extricate itself from what has proved a bad bargain; and if I do not misunderstand him this consideration is given some effect in his opinion by my esteemed and learned brother in the Eastern district, in the Saginaw case, 28 Fed. Rep., 529. But it is difficult for me to bring my mind to the recognition of this as solid ground. It seems rather incongruous as a proposition advanced to us while exercising jurisdiction solely upon the ground of that prohibition in the constitution against the impairment of contracts. On such an occasion we should naturally feel the force of what was said by the Supreme Court of Connecticut in the case of the Citizens' Water Company vs. The Bridgeport Company, 3 N. E. Rep., 809, 815, "Communities may endure monopolies, but they cannot endure the violation of contracts."

A reason advanced against the existence of an implied power to grant an exclusive franchise of this sort, is that it ties the hands of the Common Council and disables them from providing for the changing necessities of the municipality and the people residing therein, but this objection is measurably disregarded by every time contract which the city makes, and it must be deemed a consideration bearing rather on the reasonableess of the contract than as one establishing its nullity.

It is not intended to declare that the Common Council might grant an exclusive franchise in perpetuity, or for an unreasonable time, any more than it could contract for an unlimited period of supply or for an unreasonable time, for that might be regarded as an abuse of its powers and for that reason void; but short of that it would seem that the power in the one case is the equivalent of that in the other. The objection here urged, and which has sometimes been advanced as the ground of decision that the Common Council hold their legislative powers in trust, to be exercised from time to time as the public necessity may require, and that they therefore cannot barter them away, or otherwise disqualify themselves, while it asserts an undoubtedly correct legal proposition as its basis, yet does not make the necessary discrimination. Those legislative powers which concern the health, morals and safety of the public and the right of eminent domain it cannot bargain about. They are not the subjects of contract. The business contracts of a municipality stand upon an entirely different footing. Such contracts are subordinate to the legislative powers above mentioned and constitute no more of an impediment to their exercise than do the contracts of private individuals. This is clearly shown in the New Orleans case, 115 U. S. 650. Nor, for reasons there stated, is the power of controlling and regulating the streets appreciably disturbed.

The decisions of other courts hold very discordant language upon the subject. They have been very fully cited and discussed before me. I should have more difficulty in reaching a decision here if it were not for the light of reason and authority thrown upon the subject by the Supreme Court in the cases above cited from the 115 U. S. Reports. Without making a detailed review of the decisions which have been cited, it has seemed to me better to deal with the grounds and principles which have been at various times presented. To the extent that such decisions are based upon grounds shown to be untenable by the Supreme Court of the United States, they cannot be considered as having any weight here. It appears to me that the tendency of the very recent decisions in the State courts, and especially those of later date than the above cited cases in the Federal Court, is in the same direction with them. It is proper to say that there is nothing, at least in any recent case, in the Supreme Court of Michigan which is opposed to the view taken in the present case. In the case of the city of Grand Rapids vs. the R. R. Co., 33 N. West. Rep., 15, cited for defendants, it was held that the common council could not bind itself not to lay out a street over a certain line. Mr. Justice Sherwood, delivering the opinion, places the decision upon the ground that the power of eminent domain is a supreme legislative authority which is inalienable. The doctrine as applied to the facts of that case seems to me to be sound. Whether it is universally so, it is not necessary to inquire. In the case of Putnam vs. Grand Rapids, 58 Mich., 8,420, no decision was reached on any point which is material here, but in the discussion of the power of a municipality to make time contracts in the absence of legislative prohibition, and in the final disposition of the case by the opinion, it is manifest that the court considered it an open question in this State. The opinion is quite valuable as a presentation of the reasons opposed to a too strict construction of such characters.

In a number of the recent cases cited in the briefs of counsel, it has been held that in municipal charters conferring power to provide for certain public services, in language no broader than that in the charter of Grand Rapids, there rested an implied power to grant an exclusive franchise for a limited and reasonable period, in compensation for such services. These cases seem to me to be in harmony with the cases in the Supreme Court of the United States. They rest upon grounds and reasons there adopted, and on that account are the safer guides in the direct application of the law.

Upon the whole, having regard for the general municipal policy of the State, the reasons for granting the authority in question as incident to the charter powers, and to be employed in connection with their exercise instead of being dissociated and reserved, and the authority of the most controlling decisions, I am persuaded that the power to make the contract undertaken by the Common Council in the ordinance is fairly implied in the city charter. Within the bounds of the discretion confided to them in this particular, their action it not reviewable in the courts. If the power existed the wisdom of its exercise in a particular way is a matter which may be censured or approved by public opinion, but it is not within the jurisdiction here. It may fairly be said, however, that so far as appears in this case there was nothing in the provisions of the ordinance of 1880 which could be in any way prejudicial to the health, the morals or the safety of the people of the city, nor has it been suggested that the ordinance has proved injurious to the city. The contract contained in the ordinance has been disowned solely upon the ground that it was not authorized by law. That would certainly be good ground, if the fact were so, and there is no room to doubt that such an opinion might have been honestly entertained by the Common Council which granted the ordinance to the second company.

My opinion is that the ordinance of 1880 was valid, and that a contract was thereby created between the city and the complaint, which the ordinance of 1887 impairs, and that the latter is, therefore, within the inhibition of the Constitution and void. Upon these grounds the complaint is entitled to an injunction, which will issue accordingly.

The Chesley Repeater Arrangement.

With regard to the Chesley repeater arrangement recently illustrated in these columns, a valued and highly experienced correspondent writes us: "Referring to your issues of Oct. 8 and Oct. 15, I would say that the repeater arrangement therein illustrated and described is a 'chestnut' by more than a quarter of a century. The writer made one just like it at Washington, D. C., in 1862, and then and there found out why it was worthless—the least degree of high adjustment of relays for escape spoils its working entirely. Since that time, I have seen about thirty inventions of the same thing by various persons throughout the United States." This is certainly practical and to the point, and must carry weight. On the other hand, Mr. J. W. Lattig, the well-known superintendent of telegraph of the Lehigh Valley Railroad Company, writes: "If not asking too much, I would be glad, as would probably others of your subscribers, if you could induce Mr. Chesley to further describe his new repeater arrangement." Mr. Lattig is of opinion, however, that there is something lacking in the main line circuits.

Electrical Horse-Power Defined.

To the Editor of The Electrical World:

SIR: Will you kindly inform me (1) how many volts and ampères can be estimated as a horse-power? 2. Also if a 1 h. p. motor is wound for 25 volts will a battery giving a current of 50 volts run it satisfactorily, and should they be connected in series? L. B. C.

PHILADELPHIA, Pa.

ANSWER.—1. An electrical horse-power is equivalent to 746 volt ampéres or watts. 2. If the motor is wound for a *potential* of 25 volts you would probably burn it out by using a battery having a potential of 50 volts.—EDS. E. W

A Coulomb Meter or Instrument for Measuring the Consumption of Electricity.*

BY PROF. GEORGE FORBES.

During all the time I have acted as an electrical engineer my chief interest has been in the development of systems of electrical distribution from central stations. Until this plan is generally adopted we cannot hope to have the electric light supplied economically. The advances which have been made of late years have rendered the general distribution of electricity, even to great distances, an accomplished fact and a solved problem. Only one difficulty was encountered, the want of a meter for measuring the amount of electricity used by the consumers. In the old method of distribution (in parallel) the current always flows in one direction. and even here the want of a good and simple meter is felt. But in the modern system of distribution by alternate currents, no meter has hitherto supplied the want. Nearly a year ago an American in England spoke of the thing as impossible, and defied me to produce one. That same evening I went home and tried a simple experiment which convinced me I had found the solution of the problem. Of all the effects of the electric current I was sure that the only one which would suit alternate currents was the creation of heat in a conductor. The experiment I tried was to cut a circular disc of paper into a spiral and to support this spiral at its centre on a needle point. Holding this in an upward draught of air. the spiral rotates. I tested this and found that a very feeble amount of heat sufficed to produce this effect. I then put some wire under the spiral and passed an electric current through it and found that the spiral moved with an extremely small consumption of electric energy. From this beginning, after nine months, incessant work, I evolved the coulomb-meter which I now exhibit. From this work has resulted the simplest and most accurate meter conceivable, which is equally suitable for continuous or alternate currents, which is read off by indexes and dials like a common gas-meter, and which, when set in place, never needs to be touched, the readings being taken simply from the dials.

There are four dials in the latest instruments, reading units, tens, hundreds and thousands. The unit I adopt is the English Board of Trade unit, measuring the electric energy consumed in a hundred-volt lamp using one ampère of current for ten hours, the cost of which unit may be a little less than ten cents in a good system of distribution. When the inspector goes his rounds each quarter of a year, he reads off the indexes and subtracts the reading of the last quarter, and so he has directly the number of units consumed. If the lamps be not of 100 volts he must multiply his result by the volts and divide by 100 to get the number of units of electricity used up in the quarter year.

The instrument is ridiculously simple, and consists of four parts: (1) A mill-wheel (or smoke-jack as Sir Frederick Bramwell has called it); (2) a wire under the mill-wheel which creates an upward current of air when the electric current goes through it and heats it; (3) wheel-work for counting the number of revolutions of the mill-wheel; and (4) dials and indexes for reading off the number of revolutions.

The mill-wheel consists of eight mica vanes fixed by pieces of pith to the circumference of a circular disc of mica, at an angle of forty-five degrees to the horizon. This disc of mica has a circular hole in the middle, where it is supported by a thin paper cone, apex upward. At the top of the cone there is a jeweled cup fixed inside a pinion. The jeweled cup rests on a point fixed to the base of the instrument.

The wire which is to be heated by the electric current is of iron and forms a flat spiral of four turns just underneath the vanes of the mill-wheel. The ends of this wire are attached to one of the wires carrying electric currents to the lamps.

The pinion on the cone of the mill-wheel works in a train of wheels, so as to reduce the speed. One thousand revolutions of the mill-wheel indicate one unit on the dials.

Each of the dials has 10 divisions. The entire instrument is placed under a cover to keep off dust and irregular currents of air.

The instrument as now made starts with half an ampère and is fairly accurate with three-quarters of an ampère, (the amount of current generally used in an incandescent lamp). From two lamps up to thirty lamps, the speed of revolution is exactly proportional to the current passing, Fig 2. The same identical instrument will indicate from 20 to 600 lamps with the same accuracy. This is done by diverting part of the electric current from the meter by a shunt wire, so that only one-twentieth part of the whole current is measured.

If I want to measure from one lamp to six hundred lamps, I use two meters, one with and the other without the shunt. With small currents only the meter for thirty lamps is connected. When the current for twenty lamps is passing it is strong enough to act on an auxiliary apparatus which allows the greater part of the current to pass through the second meter. [The two meters are then in parallel.] This auxiliary apparatus is an electro-magnet with a coil of twenty turns of wire going to the first meter and one turn going to the second. When the current is strong enough it pulls down a lever which makes connection with the second meter and holds it there as long as it is wanted.

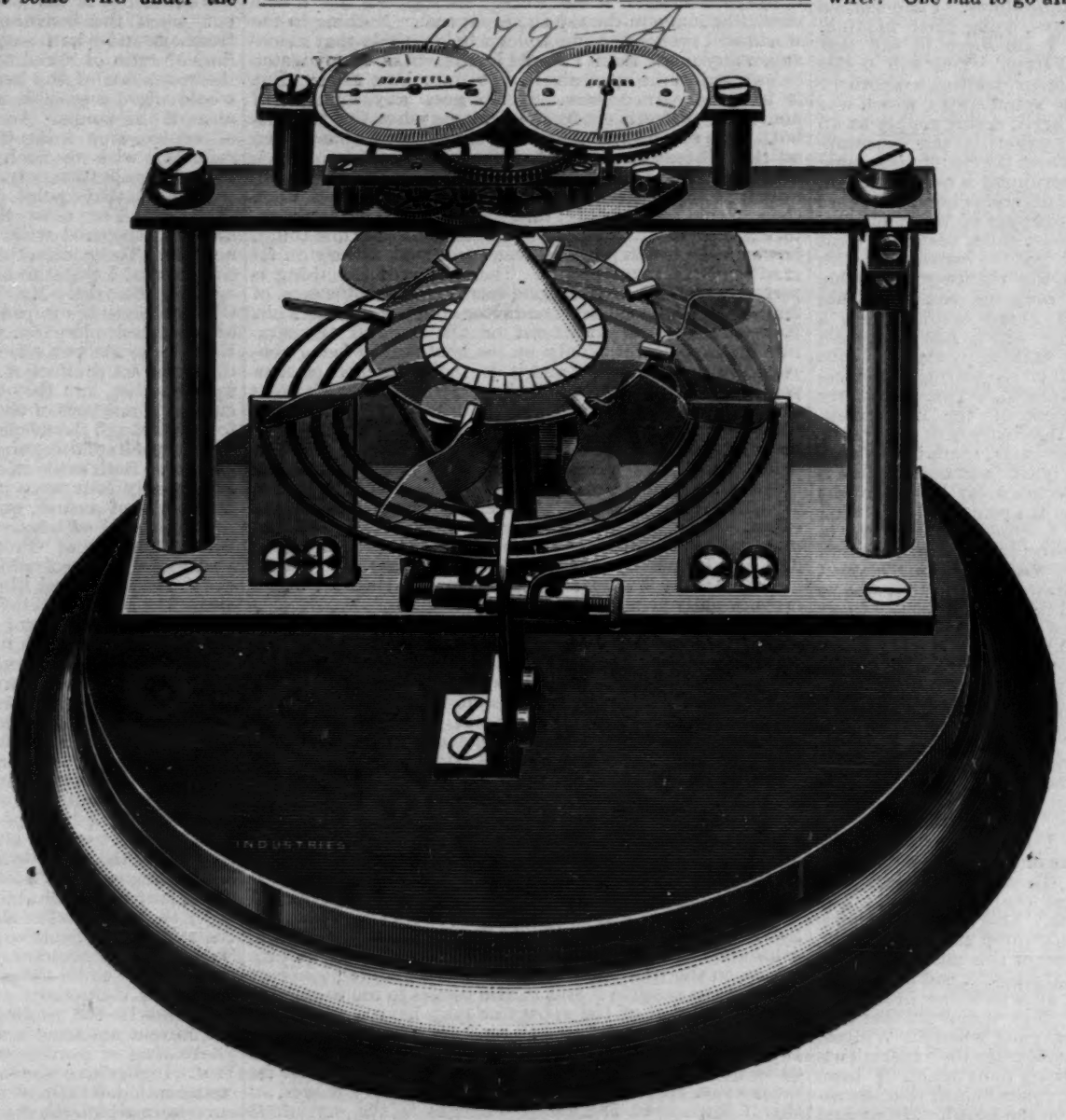
The want for such a meter has long been felt. Neither consumers nor suppliers of electric light and motive power can be satisfied with a price determined solely by the number of lamps in a house, and not by the hours of consumption. The meter must be simple and cheap, and must be readable by the consumer, as well as by the supplier of electricity. These conditions are all fulfilled by the meter I am exhibiting to you.

In isolated plants, where storage batteries are used, this instrument enables us to see how much electricity is put into the batteries and how much they give up.

In distributing motive power by electricity it is quite impossible to charge the consumer by the number of motors, because the time he is actually running the motors may be very variable. A meter is indispensable.

I may now refer you to the table on the blackboard, showing the indications of the instrument, from which you will see that the ratio of speed to current is practically constant:

Current in ampères	.25	.35	.45	.6	.75	1	2	3	6	12
Ratio $\frac{\text{current}}{\text{speed}}$	76	61.2	50.4	51	50.7	51	51	50.7	51	51.6



THE FORBES COULOMB METER FOR DIRECT AND ALTERNATING CURRENTS.

I cannot conclude this description without acknowledging the generous enthusiasm, free from all jealousy, with which this meter was received by English electricians when I showed it for the first time—namely, last month—at the meeting of the British Association at Manchester. I must say that the kind sympathy of these eminent men went to my heart. May I be allowed to quote the remarks of one or two from the London *Electrical Review*, Sept. 28?

Sir William Thomson said, "I have very great pleasure indeed in congratulating Professor Forbes. Every one who knows anything about electric lighting understands perfectly that the want of a meter is one of the greatest practical wants in connection with the introduction of central station lighting. I speak feelingly on the subject, for I have tried year after year to produce a meter. There is nothing to which I have given up so much time in endeavoring to make an instrument work as in endeavoring to produce an electric meter, and the Patent Office contains records of some of my attempts. Each one of them has been to some degree capable of giving a result, and the last of them, which I worked at a very great deal till four months ago, promised considerable accuracy, and was perfectly available for either direct or alternate currents. But the difficulty of seeing a way to bring this instrument out and to make it a practical thing, at a moderate cost, for general use, was so great that I do not feel that I intend to go on with it at all. It is just possible that I might make it succeed as a meter for a large station. But I am exceedingly glad to see the great success which Professor Forbes has obtained. I think I may say I am untinged with any feeling of regret at its having been done by another. On the contrary, it is with the most unmixed feelings that I say I am exceedingly glad, and that Professor Forbes is to be congratulated."

Professor Perry said, "One has no right to ask an inventor of such a beautiful instrument as this by what means he arrived at the idea embodied in it. I could not have imagined that he could have got this result. The figures certainly show that it is a beautifully simple instrument, and effects its purpose well. But how any one could arrive at such a method from any theoretical information passes my understanding. The whole action seems to be so complicated. I do not think I should have tried it if the idea had come into my head. I suppose one must miss a tremendous lot of valuable things in this way, because one does not see the theory. It is a marvelous thing. I certainly think it is one of the most beautiful things we have had before us for a long time. I speak now as an inventor of a meter which is in considerable practical use, not in this country, unfortunately, where it is patented, but in Germany. That is also a very simple one, but I think that this beats it."

I will not trouble you with further quotations. I can only say that I was deeply touched by the sympathy of other inventors, and that the reception I met with in England led me to take this opportunity of showing the instrument to you on this side of the Atlantic.

Prof. Forbes interpolated the following remarks during the reading of his paper:

You all remember that in England at the time when electric lighting took a decided start there was a regular rush for lighting up towns by central station lighting. I looked into the matter at that time, and I could not see that a single scheme that was then proposed was capable of being worked. We were absolutely ignorant at that time of the methods of distribution of electricity. In the first place, we were absolutely ignorant of what amount of current we might pass through the different sized wires. One had to go all through that and work out that problem before one started upon anything else. Then the different systems of distribution which had been proposed had to be discussed in each particular case to see which was the most useful, and perhaps you will remember that I myself came to the conclusion at that time that a direct supply on the multiple arc system, which was that in most general vogue in those days, could not be carried out on economical lines to a distance of greater than 220 yards, and when the three-wire system, the next decided advance, was introduced, it extended the distance of economical working to about a quarter of a mile. The greatest step, it seems to me, which has been taken in the distribution of electricity since the period when electric lighting took such a start in 1878 was the use of alternating currents with induction apparatus, which was simply achieved by the most indefatigable industry and plucky perserverance against the opinions of everybody who seemed to be capable of giving an opinion. I have never omitted on every occasion when I have had to speak about the distribution of electricity, to express the profound admiration I have had for the energy and pluck which was shown by Messrs. Gaulard and Gibbs in working out that system upon which so much ridicule was cast during the whole time they were making their experiments. At the present moment the only difficulty which has seemed to exist in the way of a general system of distribution lies in the want of a meter for the purpose. It is all very well to do as we are doing just now, to charge people for lighting their houses the same price that they used to pay for gas, or to charge them at so much a lamp and let them burn all night long or just as much as they please. That is all very well as a makeshift, but every one of us knows perfectly well that that cannot go on forever and therefore we must have a meter for measuring the consumption of electricity in houses. With a direct or continuous current, such as has been generally used on the ordinary multiple arc system or in the three-wire system, the problem is not a very difficult one, and has been solved with greater or less simplicity, with greater or less accuracy, in a variety of ways. But even in that system it has always been felt that there was great room for improvement over anything which has been done. In using alternating currents, however, there has been, until lately at any rate, absolutely no meter in existence which was capable of giving with even a fair degree of accuracy the consumption of electricity in a house.

I believe that the meter which I present before you today is as simple in construction as any meter can be which requires wheel work to indicate the amount of electricity which has been used. It has wheel work just as a gas meter has wheel work, so as to indicate upon dials, by means of indexes, the exact number of units of electrical energy, just as a gas meter measures the exact number of feet of gas which have been consumed. But in making this comparison between the gas meter and the electric meter you must not imagine that they are to be put upon a par with each other. The gas meter has become a proverbial instrument, not for the great accuracy with which it performs its work but for totally different qualities from which I trust this meter before you is wholly free. (Applause.)

I would say that the Board of Trade unit is equivalent to a thousand revolutions of the mill wheel. This instrument is made to work up to 20 ampères and it might work 20 hours a day for four or five months before the readings of the instrument would be exhausted.

* A paper read before the American Institute of Electrical Engineers, Oct. 11, 1887.

DISCUSSION.

Prof. FORBES: I would like to add one or two points about the instrument. In this instrument there is one part which I have not described to you, and perhaps before I describe it I ought to let you see it working. I will put on some battery current and see what happens. I am now starting it with a current of 11 ampères.

A MEMBER: When you stop the current how does it stop?

Prof. FORBES: It takes a little time to get up its full speed and a little time to lose its full speed. I have shown this lighter form of wheel work, and I am making it even lighter than it is in the instrument which is being manufactured now. This instrument has a good deal of metal work, much more than in any of the instruments which I have been using before, and the mass of metal absorbs so much heat that it went on for a considerable time after the current was broken. Now this might suit the suppliers of electricity very well, but it would not, of course, suit the consumers, and one must defer to both sides. I do not want the meter to act in that way, and I find that by reducing the metal work as much as possible that difficulty is taken away. There is another point about this instrument which I have not shown you or spoken to you about. It is an arrangement which is attached to it for lifting up the mica vanes against a fixed stop above. I have moved the stop away at present. That lifts the mill wheel up against the stop and enables us to carry it about with safety. That is to say, I must make one reservation—there is fear of danger if it passes through the New York Custom House. (Laughter.) I brought in a lot of instruments and after I saw a little of what the Custom House people were doing it sickened my heart so much that I let them lock the instrument up and put it in the public stores. I had worked six hours that morning like a slave, doing their bidding, and by the time it came to me I am sorry to say that many of the things were in a sad state. You will notice something hanging to this instrument (pointing to another). That was an extremely delicate spiral spring which was attached to one of these mill wheels, acting simply as an ampèremeter, not arranged for registering the consumption, but measuring the rate at which the current is passing through the conductor. That instrument is quite disabled, and others too. I have also some diagrams here. Here are actual examples of some of the readings of these ampèremeters, and I have sometimes taken them under different conditions. I have, for example, got the instrument with the clockwork in, and without the clockwork, showing the amount of friction, and I may tell you this, that it looks as if the wheelwork there would cause a considerable amount of friction which has to be got over. That friction is a mere nothing compared with the friction of the air which is circulating in these convection currents which are created. There are three frictions entering in the action of the instrument. First, there is the air friction in the currents of air, which is the chief source of friction; secondly, there is the friction of the jeweled cup on the point; and lastly, there is the friction of the wheel work, which is far less than the friction of the jeweled cup upon the point. That is what one of these diagrams shows. Another one happens to show the effect when the apparatus for fixing the mill wheel is taken out. Another one may be of some interest to you. It was taken from the instrument when it was in an experimental stage. I varied the distance of the vanes from the conductors, and I used it at $\frac{1}{16}$, $\frac{3}{16}$, $\frac{5}{16}$ and $\frac{7}{16}$ of an inch. You might expect that the nearer it was to the conductor the greater the velocity would be of the given current. That is not so. It then creates friction by pulling the air from the surface of the wire when it was too near. Three-sixteenths of an inch was found to be the most suitable distance.

There is a peculiarity about this instrument which I believe no other meter has got, and that is, I have not only my own tests of it but I have got some independent tests. I have never been able to get any independent tests of any meter in the world; but I left word before I left England, a fortnight ago, to have one of these meters finished and sent to Sir William Thomson, who was kind enough to say that he would test the instrument. The sister meter to this one was sent. This meter has an adjustment to it which no manufactured article ought to have and no manufactured meter of this kind will have; but this being in the experimental stage, it had an adjustment which regulates the depth at which the first wheel works into the principal pinion. Now it appears that that screw had become loosened in traveling when Sir William got it, and it was not found out until after the experiments were made. But the thing is being done again. I have received the test made under the conditions of that instrument which I will write down on the board. He applied different currents and he got the ratio of current to speed at these different velocities. He did not try to see what was the feeblest current he could start with. He began with one ampère and the ratio of current to speed was 66.5:

Ampères.....	1	1.5	2	3	5	10	15
Current ——— Speed.....	66.5	45	44	39	39	42.5	42

Although I look at that as very bad indeed, I think you will agree with me that that gives you a very good result. I would have been very well satisfied with that six or eight months ago; but I confess I am not satisfied with it at present, when we are able to get it so much more accurate. However, I thought it would be worth while to give you these results of Sir William Thomson. After the instrument had been going (it was one of these instruments with a large mass of metal in it) Sir William Thomson found what I have spoken to you about, viz.: that with the lower currents, after it had been running for a long time with 15 ampères, it was too favorable to the supplier of electricity and not favorable enough to the consumer. After that he put it on to 10 ampères, and he got only 37 as the ratio of speed to current instead of 42.5 as it was originally.

I think that is all I have to say about the meter. I have no doubt that in the progress of discussion there may be points of interest raised which may give me an opportunity of saying something more about it, but I think I have really touched upon all the chief points of interest connected with it. (Applause.)

Prof. Forbes then passed a current through the instrument and a recess of ten minutes was taken to enable those present to examine it. The session was then resumed.

Dr. VANDER WEYDE: Is it the intention to have that apparatus under that glass shade while in operation continuously?

Prof. FORBES: At the present moment I intend to use the glass shade, although I have no great preference for it. If any one has any objection to it, a metal one is just as good, only one would need a glass window to read it by.

Dr. VANDER WEYDE: The objection to it would seem to be that when the apparatus is in operation a little while the air will be heated and the ascending force would diminish and become very small, at least when the air was considerably heated in the glass shade. To correct that, nothing would be easier than to make an opening in the top of the glass shade to let the hot air out and keep the surrounding atmosphere more uniform. The apparatus would give an indication of less velocity if the air is made warm than if it is cooler. When the apparatus has been in operation for some time so that the air becomes heated which surrounds it, the indications would become a great deal less. I wish to do justice to Prof. Forbes for the ingenuity of the apparatus and the remark I made is only for the purpose of suggesting something which may make the apparatus more perfect.

Prof. FORBES: These are very suggestive remarks that come from Dr. Vander Weyde, and of course they occurred to me during the process of the experiments. There is one lesson that I have learned from this instrument, which is, that you cannot calculate on what is going to happen with a convection current. (Applause.) I have been as sure as possible, over and over again, when I was making a minute change in the instrument, that I knew as well as possible what it was going to do, and it never did it. Dr. Vander Weyde suggests that when the air at the top of the shade gets heated the instrument will go slower. The only answer that I can give to it is that it does not. It goes perfectly continuously, however many hours that I have it at work. He suggests that a hole should be made in the top to keep it cool. Nothing in the world will ever induce me to let a hole get into that mechanism any more than I would let the works of my watch be exposed to the open air to get dust into them. But it is quite unnecessary, for it goes any number of hours at a perfectly constant rate, even when the top gets hot. It is remarkable that the first person who has spoken at this discussion has raised the first objection which every person who has ever spoken to me about it has raised, and that is that its indications will depend upon the external temperature; that when the external temperature is high it will go quicker. This is the only one thing, however, in which practice does agree with theory in regard to convection currents. The theory of the thing is perfectly simple. The moving force is the *difference* of temperature between the conductor and the external air. It does not depend in the least on the *absolute* temperature of the place, it is only on the heat that is being generated in the conductor, and it is the difference of temperature created therein and the external air which gives you the moving force. It is a matter of indifference whether you start with a temperature of 80 or 100 degrees. As a matter of fact, the indications in a warm atmosphere and a cold atmosphere are identical. I may forestall the question that is going to be asked immediately, whether the barometer has any effect. I may say that I have not had the instrument under an air pump to test it, but I have tested it day after day, and I have seen no perceptible variations.

Dr. VANDER WEYDE: What becomes of the heat which is continually generated?

Prof. FORBES: It is radiated from the surface of the glass. A great deal collects at the top. A fixed temperature is arrived at of course, and the heat which is being created is all radiated from the surface of the glass.

Mr. FRANK L. POPE: The amount of heat which is generated by the action of the current is not very great at the most, and as it gradually collects in the top of the glass, it is probable that before the hot air extends down far enough to affect the operation of the instrument the radiation has become great enough to carry away an equal amount of heat with that which is being generated, and the temperature from that on is stationary. The balance is brought about before the currents of air are affected sufficiently to affect the operation of the instrument.

Mr. MAILLOUX: There are some other points which I would like to bring forward. One point is about the friction of the apparatus. I would like to know whether the calibration of the apparatus does not depend for its constancy on the friction of the apparatus remaining constant as nearly as possible; and it also occurs to me to suggest that the friction of the apparatus may have a great deal to do with its sensitiveness as an integrating instrument. In other words, if there is very little friction, it is quite likely that the inertia would be greater, and its momentum once obtained would tend to carry it over, so that if there were any abrupt changes in the current it would not so readily respond to them. So that if we were to draw a curve of variations of current it would in reality not follow that curve closely but only partially, introducing a quantity in the result which would be the analogue of self-induction with an ordinary apparatus. Now there is another point. We all know that in order to obtain heat from a conductor we must have a certain amount of resistance, and I would like to know whether the amount of resistance that has to be introduced in the wire (which I presume is iron from its appearance) is of material consequence, whether it would figure at all as an element of resistance of the whole circuit, and also whether, by virtue of its resistance or of its position, it would introduce any variation which has been called impedence in the circuit in consequence of self-induction or anything like that.

Prof. FORBES: The first question, as to the effect of the constancy of the friction—whether the speed of the instrument depends upon the constancy of the friction of the solid parts—and the second question I had better take in connection with it, which is, whether that friction of the solid moving parts renders it less sensitive. First, we have to consider whether, after the lapse of months or years, when the mechanical parts of the instrument are not in such good order as when it was started, its readings will be as accurate as they were at the beginning; and in the second place will it be so ready to start with a feeble current with the friction of the wheel work as without it. I have already said that the most important part of the friction in that apparatus is the air friction; but that is especially so in the case of a larger current. When the currents come up to the average strength or greater, the air friction is out of all comparison the greatest friction that we have in the instrument. At any time the friction of the wheel work, incredible as it seems to most people at first sight who are not accustomed to thinking much of the subject but a fraction of the friction of the jeweled cup upon the pivot. You must remember that the first wheel of the wheel work is rotated at only one tenth of the speed of the mill wheel, and its weight is extremely light compared with the weight of the mill wheel, and the friction of the first wheel is therefore very slight indeed; and when you come to the second wheel, its speed of rotation is diminished tenfold and its lightness is small compared with the mill wheel. I was told to expect this by a great friend of mine whose name I ought always to mention in connection with this instrument, Mr. Augustus Stroh, who assisted Sir Charles Wheatstone in all of his celebrated inventions and who has assisted me in all this work, and there is no man more capable of giving such assistance in the mechanical details of an instrument like this. I had intended to make a German pun, a thing I never did in my life before, and should have done so if it were not for the earnest objections of Mr. Stroh, and call this a Strohmeter. (Applause.) That is the way that the friction of the apparatus comes in. It is very slight indeed compared with the air friction, except with very feeble currents indeed. The result always, then, has been that what I call the ratio of speed to current was constant whether the friction were a little more or a little less, but that it did not start quite so easily with extra friction, and I have no doubt that if the wheel work were to get seriously out of order, and we were to have very much more friction, it would not be so sensitive to a single lamp; but at higher speeds there would not be the slightest difference in the indications. For example, to show you how that works, I have two diagrams giving you the ratio of current to speed when different currents were passing through with the clockwork attached and without the clockwork attached. You would notice in these that with the clockwork attached it did not start with so small a current, but when the instrument was once in working order, from one and a half ampères or so, or upwards, the two lines of ratio of speed to current were identical. As to the resistance of the instrument, I am asked whether it would afford a sensible amount compared with the resistance of the lamps. As soon as it does that we must, of course, stop using it. I have never been able to raise this wire to such a temperature that it did not indicate proportionately. I have had my wires red hot, and up to that point it was still indicating proportionately. You must simply stop using it when its resistance compared with the lamps is something you do not like. There is another question asked which raises a subject that I ought to have spoken more fully of in my opening remarks. Mr. Mailloux has spoken about Mr. Oliver Heaviside's impedence. He asks me whether the effects of self-induction are perceptible in the instrument. Now, there are two effects of self-induction in a coil like that; one is the effect of induction of one turn of a spiral upon another, and the other is the concentration of the current in one part of the wire, not allowing the current all to pass through the whole section of the wire equally. These are the results of using an interrupted current or any variable current. Both these effects come into play. In this case I have only four turns of the spiral, and their mutual influence is, of course, quite insensible. Many of you, I presume, read with interest equal to my own the delightful researches of Prof. Hughes on self-induction a year and a half ago, which he gave to the Society of Telegraph Engineers and Electricians, in London. You will there find recognized the fact that a variable current passing through a conductor does not pass equally through the different sections, and it has been more generally recognized since that time, than previously, that there was a greater resistance in a given wire to a variable current than to a steady current. Prof. Hughes undoubtedly showed that this change of resistance is far greater in iron than in other metals. The metal I use for my conductor is iron. I confess that, having these experiments in mind and having followed out Prof. Hughes' experiment myself in the laboratory to a considerable length, I did expect to find a change in the resistance when I used an alternating current, and I expected that to use the same instrument for both continuous and alternating currents would necessitate the employment of a constant by which the readings should be multiplied in order to suit it for the alternating current. I confess with the utmost gratification that on testing it by means of the Siemens dynamometer on the alternating current and using the same Siemens dynamometer in testing it for the continuous current, there was absolutely no difference in the readings of the instrument so long as the current remained constant, whether the current were alternating or continuous. I then remembered that all Prof. Hughes' experiments and all those I had made in continuation of them were done with a made and broken current in which the rapidity of change from no current to the maximum of current is terrific, and that the very rapidity of change is what produces the spurious resistance, that apparent greater resistance when the broken current is being used; and that when we are using an alternating current, which alternates, it is true, very rapidly but in a variable manner, and whose variations are not commensurate with the rapidity of the variations in the interrupted or broken current—in that case these effects which were so startling in Prof. Hughes' experiments do not appear sensibly. At any rate, as a matter of fact, with alternating currents and continuous currents the instrument reads identically. No constant requires to be introduced.

Mr. S. S. WHEELER: I would like to ask what the resistance of the coil used is?

Prof. FORBES: Nearly a tenth of an ohm.

Mr. WHEELER: And I would also like to ask if you cannot overcome the effect of induction by reversing one spiral on the other?

Prof. FORBES: Perfectly; but there is no effect of induction.

Mr. D'INFREVILLE: The instrument being so sensitive, is it not desirable to take some special precaution to prevent it from registering when no current passes through it; for instance, put it in some place where it will be subjected to a current of air, or the radiation from the sun or hot air?

Prof. FORBES: No, I cannot say that it is. When it is under a shade, as far as I remember, I have no recollection of ever seeing the thing moving when there was no electric current passing through it. I am pretty sure it never does move; but you must remember it requires to go round a thousand times before it registers a sixpence worth; so, even if there were a few turns, it would not matter a bit.

Mr. MAILLOUX: I want to say that there is one point in the questions which I asked that Prof. Forbes did not fully

answer, though he has since nearly answered it in reply to my friend Mr. D'Infreville. It is in reference to the sensitiveness of the machine as an integrating instrument. In other words, if you take the rates of variation of a current that is not varying at too rapid a rate and then a current which we will say is comparatively steady, but which is suffering some periodical variations, then we will find that the increase of speed of the mill wheel will be a little more and that it will dally a little behind. In other words, we would find that perhaps these waves would not be followed so closely. That is what I meant by impedence and the factor which would be the analogue, though not the exact equivalent, of self-induction.

Prof. FORBES: The momentum of the apparatus has no effect, as it is extremely trifling. As soon as the momentum tries to carry it around at a different speed from that which is determined by the velocity of convection currents, these vanes are pulling every way through the air and act as a drag on it, and it immediately suits itself to the velocity of the air currents. Since that question has been raised, I would like to say this, that you must not expect the instrument to go jumping about at a very rapid rate with a change of lamps. With a small current it takes about five minutes to settle down to its readings. With the large currents it takes about a minute. So that really if these were the variations in the current (illustrating), in all probability the reading you would get would perhaps not reach its maximum quite so soon, and here, again, it would have a curve whose variations would not be quite so great.

Mr. MAILLOUX: That is exactly what I mean.

Prof. FORBES: That is not due in the least to any momentum in the instrument. That is due to its taking a sensible time to accumulate heat in the wire and a sensible time to get rid of the heat accumulated in the same.

Mr. SHELBOURNE: The Professor said it took about five minutes to get its rate of motion in the mill wheel with a feeble current. Now, in regard to the first question that was asked by Prof. Vander Weyde in respect to making a hole in the top, does it not appear that the apparent inaccuracy of the instrument in registering light currents and in getting its rate may be due to the generation of heat at the commencement, and that heat accumulating in the top of the instrument and heating the glass, it would arrive at a point where there is an equation between the generation of heat by the wire and the radiation from the outside of the glass? I simply suggest this and I ask the Professor whether he ever has tried in making instruments, instead of making the whole of the cover of glass, to put a dome of copper or some other conducting metal upon it, so that the air which rises and accumulates at the top may sooner reach that equation of radiation from the outside of the instrument with the generation of heat which operates the mill wheel.

Prof. FORBES: I am asked as to the inaccuracies of the instrument with a feeble current and the cause of it. I confess that as a user of the meter I have not the slightest objection to its not indicating at its full speed for the first five minutes when you are using very feeble currents. The monetary value of such a thing is inappreciable. If we were wanting to use the instrument to determine the true value of the ohm or any of those profound researches it would be right to go to very great accuracy. But I do not think it is necessary to go to any greater accuracy than we have at present on that point, and to make the feeble currents begin their accurate reading a little sooner. I really do not think that practically it is very important. Otherwise, I think the suggestion that was made very likely would be good—using a metal shade. Of course I have had numerous changes in shades. I have tried a shade which was nearly all metal. But I found this shade before you the best one I have used up to the present time. However, I think it is quite likely that the suggestion just made might be a good one—that a metal shade would be fully as good as the other—might be better, and might make it a little more sensitive perhaps. I think there may be a good deal in what you say.

Mr. WEIZLER: I have no doubt that the instrument in its present shape has gone through sufficient experimentation as to make any suggestions regarding its history a little out of place. But I am a little interested in knowing whether any experiments have been made to determine the best angle and shape of the vanes of the mill wheel, and if the shape determined on there has been found to be the best.

Prof. FORBES: As to the angle, I have committed the grossest folly that a man with the experience I have had with this meter could commit—I have trusted theory. I have been positively certain that an angle of 45 degrees must be the best. I am sorry Mr. Wetzler has drawn this confession from me, because it is really the only respect in which I have trusted to theory. As to the other points, the shape of the vanes has been the source of endless experiments. I made an enormous number of changes before I arrived at this shape, and even little details in the shape have come from experiment. I made hundreds of vanes in the experimental stage, and I am pretty sure that if that type of mill wheel is to be used the vanes are of the right shape.

Mr. RIES: Prof. Forbes mentioned at the outset that his attention was drawn to the devising of this meter by the fact that no meter existed for measuring alternating currents. Now during the elaborate discussions we have listened to this evening nothing was said about its application to alternating currents. Many would like to hear from Prof. Forbes as to its use in that connection, and if the meter is specially adapted to alternating currents where other meters heretofore devised are not applicable to that purpose.

Prof. FORBES: Meters in the past have been constructed by the use of, I think, only two principles of electrical action; the one being electro-chemical action and the other electro-magnetic action. Several instruments have been devised with electro-magnetic action as their basis; but those which were sensitive enough to be practical were obliged to contain iron in their construction. I do not know of any meter which has been brought into practical form which does not depend on one or other of these two principles—the electro-chemical or the electro-magnetic principle. In an alternating current, the current is of course alternately going in opposite directions, and in any electro chemical arrangement which may be used, whatever is done by the current when it is going in one direction is undone by the next alternation of the current. So that it seems to me hopeless to think of designing a meter upon electro-chemical action. The designing of a meter on electro-magnetic action is a far more hopeful thing; though even in continuous current meters I believe the difficulties have not been altogether gotten over; but in using alternating currents the phenomena of self-induction come in, and not only that but also the fact of your having iron. The intensity of the magnetization of the iron depends upon the speed of the alternations; so that as a matter of fact it has been found in every meter which has iron in its construction that the indications of the meter, even if you keep the current perfectly constant, are totally different when the speed of the engine varies; that is to say, when the number of alternations per second is changed. So that if you were testing such a meter you would test it at one speed and you would get at its constant, if it had a constant, and then you would give it to your consumers, and of course you would not run your engines at that speed; you would run at a totally different speed, which would favor your suppliers (laughter). I think it is immoral to suggest such a thing as that; it lends itself to fraud. That is the objection to the electro-magnetic meters—that they give totally different indications even with the same current, when the speed of alternations is changed.

Mr. F. L. POPE: The action is analogous to that of a gas meter when you change the pressure?

Prof. FORBES: Yes; like a gas meter when you change the pressure. It was thinking of these things and thinking also of other effects of the electrical current that made me conclude that the only thing which would do was heat. I have often thought of the question of meters before, and although your president has been kind enough to say that I have invented one or two things, I always tried not to invent, if possible, because that is not my business. My profession is consulting work. But sometimes it is irresistible, and when a man defies you to do a thing which you know you can do, it is totally irresistible. I had been thinking over the matter a good deal before, but I never had made up my mind how I was going to do it; but so soon as this defiance was put before me I immediately hit upon this way of doing it. The reason then why this is suitable to alternating currents is that it measures the heat generated; it measures the energy which is used up; it measures a certain fraction of the energy which is being used up in the lamps, and that is what we want to measure, and it will do so whether we are using alternating currents or continuous currents.

Mr. RIES: The speed of the alternations per second has no effect?

Prof. FORBES: It has no effect upon this. This simply measures the energy—a certain fraction of the energy of the lamp.

Mr. WESTON: I do not know that I can say very much more than has already been said in regard to the instrument by Prof. Forbes. I think it is an extremely in-

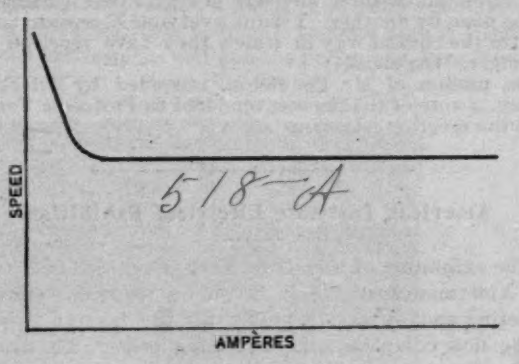


FIG. 2.

genious and beautiful instrument. There has been already a great deal of time and a large amount of money spent on electric meters for direct currents, and I can say with Prof. Forbes that I do not think we have had any current meter of any value whatever. The electro-chemical system in use by a very prominent company here was put out with a great deal of confidence with the results to be obtained from it. I think any one looking at the principles involved would condemn it from the start. You are to take a small fraction of the total current, and a very small fraction indeed, and pass it through an electrolytic cell, the character of which varies from time to time, so that the resistance is never fixed, and pass the bulk of the current around a resistance which is practically fixed. The change in the resistance of the metal would be but a small proportion of the change in the resistance of the electrolyte. Now in such an instance as that you are measuring a very small fraction of the current passing, and whatever error you have you are multiplying that error by that fraction. If you are measuring 1-1000 you are multiplying your error by 1000. Any one who has had much to do with electro-metallurgy knows that the cells are constantly changing; that to keep the deposit regular and uniform, to keep the resistance of the solution uniform, they must be constantly attended to. There is not an electroplater in the country who does not once in awhile go in and stir up his baths. Such an instrument is of no real value. We may, therefore, dismiss those instruments entirely from consideration, I think. A great deal of work has already been done on magnetic instruments; that is, instruments which depend upon the magnetic attraction of the current through a wire, or the current through a wire going around an iron coil. In those instruments we have all the defects which have been referred to as being possible to exist in this instrument here to-night, manifested a thousand times more, with numerous others that do not exist in this instrument at all. I can speak feelingly on the matter, because I have given a great deal of attention to it, and have thought once or twice I had something very good, and have been finally obliged to abandon it. If any one will take the record of the Patent Office on electric meters, he will see there has been no small amount of time and thought and money spent on that question. Practically, we are in the same position we were before. We had nothing except the electro-chemical meter, which, as I say, I consider entirely worthless. Instruments have been built which are approximations, but nothing in comparison with this, and if they were they would not be of as universal application as this instrument is. This instrument is applicable to either alternating or direct currents with the same practical degree of accuracy, a thing very much to be desired, particularly in the present state of the art. I will refer a little to some instruments that have been built in my own laboratory, just to give you an idea of the ingenuity and skill displayed in working this instrument of Prof. Forbes, and how nicely it overcomes all the difficulties. (The speaker here made a sketch on the blackboard.)* We have here an ordinary magnet with the so-called consequent poles, which in this case are in the form of discs instead of being curved out for the insertion of an armature. These poles are brought as close together as they possibly can be. An annular chamber runs around the lower pole, in which mercury is poured. A mercury cup was also placed on the base of the instrument, in the end of which was inserted a cork float, to get as little weight on the pivot which entered the stem here as possible. This stem passed up right through, connected with the disc at the centre and then engaged a wheel work similar to the one that Prof. Forbes has here for the purpose of registering the number of revolutions of the disc. Now if this magnet, which was wound with very fine wire, was placed and so proportioned as to be saturated with the maximum current that would be likely to flow with the difference of potential on the circuit, *i. e.*, if the core was kept constantly saturated, then a current passing would go through the disc readily, down through the cup and out through the frame of the magnet, the magnets being placed in derived circuits so as to keep them constantly in the point of saturation. Under these circumstances, of course, we should have a series of radial currents flowing out from the centre to the periphery, or vice versa. Such being the case, the disc would commence to rotate and record the number of revolutions on the little wheel work or registering apparatus employed with it. This instrument was the result of a great deal of hard work. It has been absolutely abandoned, and stands on my laboratory table now, and has not been touched for two or three years. The instrument, however, within certain limits was really admirable, but those limits were so narrow as entirely to prohibit its use for practical work. When the speed varied the element of friction in the mercury came into play and very seriously changed the rate of revolution of the instrument. I do not know whether Prof. Forbes has done any work on the friction between a mass of metal revolving in mercury or not.

Prof. FORBES: I did a good deal of that at one time.

Mr. WESTON: If you did, you will understand the difficulty. Nothing was accomplished. Now, when I come to see an instrument of this kind, after the amount of work that has been put on it, it makes me ashamed to think that I spent so much time on a thing of that kind. I may say that it has already given rise to a very neat form of current instrument in which, instead of having the disc rotate, it was fixed, a large index being brought out from the disc, in which case it was absolutely proportional to the number of lamps in circuit. For a station ammeter I do not know of anything that equals that to-day. It shows the current when there are 300 or 400 or 500 on, just as it shows one lamp by itself. Prof. Forbes has got here the simplest instrument that I think could be built. I do not see how you could improve it very much except in detail. The principles are correct, and I must congratulate him very highly indeed upon the success of the instrument. (Applause.)

Mr. RIES: After Prof. Vander Weyde's suggestion, which was the first one made this evening about the hole in the glass shade, it occurred to me that perhaps another principle besides those mentioned by Prof. Forbes might be utilized in the construction of a meter of this class. Prof. Forbes mentioned electro-chemical action, electro-magnetic action and caloric, or heat, as the basis for a measuring instrument of this kind. Now, if we could obviate the friction due to the revolution of these vanes in the air, and place them in a vacuum, like Crookes' radiometer, and instead of utilizing the principle of heat use that of light to give motion to the vanes, I do not know whether that would not make a very delicate apparatus. It suggests a different direction in which to work. You might perhaps take these vanes and place them in a dark cell, surround them with a strip of platinum wire or carbon filament, and use the variations in light to change the number of revolutions per second, and that could be recorded by an apparatus similar to that used by Prof. Forbes. I simply offer that as a suggestion.

Mr. WESTON: I did not speak of the general class of meters. There are such meters as are dependent on the action of clockwork. A good deal of work has been done on those. I think Mr. Gardner took out one of the first patents. In this case, I think, the clockwork was to keep the gear wheels moving at uniform rates, and the device for transmitting that through the recording apparatus was to enable a change to be made in the rate of recording. Of course there has been a great variety of instruments of that class designed. Then there have been a class designed which have contemplated the quantity of gas generated by electrolysis. That can be used; but the same objection holds in that that holds in the other one, viz., that you cannot put that instrument in the direct circuit. It must be in the derived circuit, and you must then measure the gas, which introduces a great many errors which have to be compensated for. Then there have been other instruments in which it has been proposed to use strips of paper running under a stylus which could be moved more or less by a magnetic current. But you can see, when you sift them all down, that there is not one which is applicable to any system of work that is now in use. This instrument appears to me to be so applicable. Some people may say that is a very delicate instrument. Well, there is a great deal of very delicate work about electric lighting, and the sooner we get the men who are delicate enough to handle it the better we shall be off. You cannot wait for men to be educated, or depend upon men entirely. You have got to run on with the art and the men must grow up with it. A few years ago there used to be no ammeters. Voltmeters used to be ridiculed. Everything was rule of thumb. People are beginning gradually to see that it is necessary to use instruments. They find it on the balance sheet. I would just as soon think about running a manufacturing establishment, where electrical apparatus is made, without delicate measuring apparatus as I would think of running a machine shop without delicate measuring apparatus. It is just as foolish to try to get along with a foot rule as your standard in a shop without using standard gauges. The man who works to one quarter of 1-1,000, which should be the absolute limit on all first-class work, is the man you want to employ. He will save you money, because he will do your work the same way every time, and there will be no tinkering and pottering to get things together. (Applause.)

Mr. HOWELL: I was very much surprised to hear what Mr. Weston said. I am surprised that he does not know

*For illustrated description of the Weston meter see THE ELECTRICAL WORLD, March 13, 1886.

that there is a temperature correction in the Edison meter. The Edison meter has been in use industrially for five years, and I say without hesitation, and I am in a position to know the opinion of the practical men who are using the Edison meter, that they think a great deal more of it to-day than they did before, and the more they use it and the more they know of it the better they like it. There is one thing about that meter of Prof. Forbes which recommends it to me as the result of experience with instruments sent out for general use. There is one peculiarity about every American electrician, and that is, he has got to know what things are made of, and if you do not show him he will find out for himself. Now that instrument shows itself. You can look at that and see what every part is and you do not need to take it apart. I have sent out a great many instruments. The first thing a man does with them is to pull them apart and see what they are made of. There is no necessity for pulling that instrument apart; you can see all about it. There is one thing I would like to ask Prof. Forbes, and that is the effect of lowering the shade. I see he has a shade there very much higher than the instrument apparently needs. I would like to know if that is necessary to allow for air circulation.

Prof. FORBES: Yes; it is more sensitive with a higher shade. That is about the limit. I have gone through dozens of shades to see what is the right size and shape and that is the one I fixed upon.

Mr. HOWELL: The impression that instrument makes upon me, and upon a good many I should think, is that that there would be a difficulty in shipping it and getting the men who have to put it up and use it to do so properly. I know that the men who will use those meters, the men who do our meter work in electric lighting, are not men in whose hands I would like to put an instrument of that sort. How is that shipped may I ask?

Prof. FORBES: I packed the glass case separately when it came over. On this occasion I took off the vanes. I had three parcels for that instrument, one containing the clockwork and all the brass work you see there; another containing the mill wheel and another containing the glass shade. They have traveled in England very large distances with that arrangement in action, which I pointed out before, by means of which the vanes are pushed up against a stop. The person who was going to use it had nothing to do except to tighten up a screw as hard as it could go and then it was free to work. There was absolutely nothing to be done except that, and I think I should do that in future if I replaced that glass shade with a metal cover. I have not replaced it with a metal cover, because you can see it work. I like the glass shade, but, I dare say, a metal shade with a window will in practice be the thing that will be adopted, in which case the whole thing will be perfectly safe to pack up in one piece. I shall certainly not allow the workman who uses it to touch the mill wheel. I shall have that arrangement which is on it now for lowering the vanes on to the point.

Mr. WESTON: I take it, gentlemen, that the instrument exhibited here is not intended to be the instrument in use. We know that people do a good deal to get around meters. Gas companies will tell you that the people will punch a hole through. But of course it is practicable to protect that as well as we can protect anything. In regard to the electrolytic method by the direct current I think I am aware, and I have been aware for a long time, that Mr. Edison has had a temperature correcting device in circuit that will work within certain limits. I still say, and I say it without any fear of being proved incorrect, that such a meter cannot work successfully and practically within the limits that it ought to work, and I think that is the universal testimony of consumers at any rate. I suppose there will always be more or less complaint by consumers about all kinds of meters, but I think they have been pretty well founded in that case, because I think the meter is incapable of doing as good work as we want a meter to do. I do not mean to say you cannot make a meter that will work.

Mr. CROCKER: I ran roughly over the amount of heat that would be generated in Prof. Forbes' instrument, and it came so high that I should like to go over the figures now and see if they are right. He says the resistance is under a tenth of an ohm. Assuming it to be the tenth of an ohm, 20 ampères would give two volts drop, and two volts and 20 ampères would give us 40 watts; and 40 watts multiplied by 44.2, which is the only equivalent which I happen to remember, is about 1,760 foot-pounds, and 1,760 foot-pounds gives us two heat units, roughly. That is, two pounds of water will be heated one degree Fahrenheit in one minute by Prof. Forbes' resistance when it is working up to its full capacity of 20 ampères. Two pounds of water heated one degree is equivalent to eight pounds of air heated one degree. I believe the specific heat of air is a quarter that of water. That is my recollection; it may be wrong. There are eight pounds of air heated one degree Fahrenheit. Now the contents of that shade there are approximately a quarter of a cubic foot. Therefore, the heat produced in that shade would be fifty times as much as it would be in one pound of air—8 times 50 is 400, therefore we have 400 degrees per minute. It is a very high figure. I cannot believe that it is right. But we know that the capacity of the amount of air in that shade for heat is very small, and we also know that the amount produced in a tenth of an ohm by 20 ampères of current is quite large. Therefore, perhaps, that figure is approximately right.

Prof. FORBES: I think perhaps it would be better if I might be allowed to answer the question after it has been written out by the short-hand writer. It is rather difficult to follow the point where we went from water to air, and the larger quantities, and to see that the figures were right. But I do not see that the quantity of air that is heated, or the quantity of water that is heated, has anything to do with the question. I would suggest that the speaker, instead of taking that line, would simply multiply and find out how much energy is used in the meter when 20 lamps are burning, and divide one by the other and get the percentage. Settle upon the percentage, more than which you are not going to use, and you have it. I should think very much over 2 per cent. or so would be very undesirable to use. In some cases it might go up to 3 or 4 possibly, but I should think as a general rule you would find 2 per cent. as much as one would care to use. The question of the number of lamps you use simply depends on what amount of energy you care to use.

Mr. CROCKER: I did not mean the efficiency of the apparatus. I did not mean that Prof. Forbes' meter used up any considerable fraction of the current. I merely meant to bring forward as an interesting point exactly how much heat is produced in the meter in a given time and to calculate it as well as I was able to with the figures I happened to have in my mind.

Prof. FORBES: Then I would point out that theoretically you have to take in another point, and that is that there is continual radiation going on, and that during constant running there is no addition to the heat contained in the instrument. It arrives at a constant condition when the heat generated in the wire is equivalent to the heat radiated from the surface of the glass. From numerous experiments, both in Sir William Thomson's laboratory and also by Prof. Tait, we have got at the constant of emissivity, the rate of radiation, and it is very easy to go on with the calculation a step further than done just now, and calculate what is the temperature which would be reached when the emissivity or radiation from the surface is equal to the heat generated from the wire. The problem looked at simply as a theoretical problem of interest can actually be worked out by going a step further than the speaker has just stated.

Mr. WHEELER: What is the approximate temperature of the meter after running a few minutes?

Prof. FORBES: Running at its full, it is 120 degrees, perhaps.

Mr. WHEELER: Even at that low temperature it must get enough higher than the surrounding air to radiate 2½ heat units.

Prof. FORBES closed the discussion, as follows: I feel that this discussion has been of great value to all of us Very interesting points have been raised, and I have heard suggestions which have given me great interest, indeed. Of course, in working at this instrument one started from theoretical notions, but one gave them up very soon, and one had all sorts of resources at one's hand to vary the forms of these curves, some of which I have already shown you. I should like to show you the curves which I got when I first made this instrument. The curve ought to be simply a horizontal line. One of the curves which I first got was of about this shape (resembling the letter U), and yet I had the greatest hope even when I got that. By two changes I was able to reduce the line down to a horizontal, and there were numerous other changes. In the course of working that instrument out I learned more about convection currents than I knew there was to learn, and really one has power now to handle them as one pleases.

I have no more remarks to make, except that I thank every one here for the pleasant discussion we have had this evening. I think it has been very instructive, and I have felt throughout the same kind, cordial sympathy that was shown in England. I did not expect to find everyone ready to look upon it in the way in which Sir William Thomson did, without any sign of regret that it happened to be done by another. I thank everyone here most heartily for the cordial way in which they have received this stranger. (Applause.)

On motion of Mr. Pendleton, seconded by Mr. F. W. Jones, a vote of thanks was tendered to Professor Forbes, and the meeting adjourned.

American Institute Electrical Exhibition.

The exhibition of the New York Electrical Society, at the American Institute, is becoming every day more interesting and attractive, nearly all the leading displays being now complete and in running order. The attendance continues remarkably good, and the amount of interest developed in the various electrical features is most encouraging. The electric lighting dynamos and the motors running various machinery are especially attractive, and it is evident that a very large section of the population of New York City is now taking its first lessons in applied electricity, and acquiring information about devices and applications of which it had previously no conception. The historical exhibit is also assuming great importance, and besides being the first of the kind ever made in this country is already far larger than the committee in charge had hoped to make it. Much credit is due to Mr. J. Hamblet, who has supervision of this exhibit, for the success obtained. In addition to the collections from the Franklin Institute, the Stevens Institute, Dr. Vander Weyde, Mr. R. G. Brown, Mr. J. A. Seely, Prof. Moses G. Farmer, Mr. C. B. Hotchkiss, and others, the Gold and Stock Telegraph Company have now contributed some very early apparatus; and Mr. James D. Reid has kindly loaned the original sketch book of Prof. Morse, showing the early conceptions of his electro-magnetic telegraph. Altogether, the exibit is one in which several hours can be profitably spent. Since last week, the coulomb meter of Prof. Forbes has been placed in the general exhibition, and like that other novelty near by—the writing telegraph—pleases many visitors. Below we continue our notes of exhibits.

THE SANFORD FIRE ALARM.

Under the head of "Fire Alarm Telegraphy" is exhibited an apparatus devised by Sidney J. Sanford, of Barrie, Ont., intended to be placed in the fire station, to show the number of any street box that may be started. This apparatus works very quickly, and shows the number in figures, as well as ringing all the usual gongs and bells in each station house, and afterwards ringing the tower bells, if such bells are used in the system. Its action is as follows: On a street box being started, all the bells and gongs will give one stroke, to notify the firemen, and release the horses. The machine will then show up the number of the box, and afterwards the number will ring on the gongs and tower bells. The apparatus can be attached to any system at present in use by a slight alteration in each street box, and placing the machine in each fire station. It saves time over the present methods in use, it is claimed, first, because it shows the number more quickly than is done at present, and also because it saves the time required to count the number as by the present register is necessary.

The same apparatus is used for a hotel annunciator and district messenger register. As hotel annunciator it requires less room and less attention than some others, as it will set itself after each call. The same may be said for it when used as a district messenger register.

THE RIES ELECTRIC TRACTION-INCREASING APPARATUS FOR RAILWAYS.

One of the most recent as well as one of the most valuable and interesting of the electrical exhibits is that of Messrs. Ries and Henderson. This exhibit is at present in charge of Mr. Ries himself, and attracts a great deal of attention, even from non-scientific visitors, who view with mingled wonder and delight the novel spectacle of a model railway car ascending, without the slightest difficulty, a grade upon which an expert tobogganist might fear to entrust himself for a downward trip. The outfit comprises two model railway tracks, each capable of being elevated at one end to various heights, with a motor-car for each track, and a dial for registering the amount of pull or tractive force exerted by the cars under different conditions. The Ries electric traction-increasing system embodies a new application of electricity, one that gives promise of a wide and extensive field of usefulness, especially in connection with steam and electric railways, and is particularly valuable at the present time in view of the possible influence it may bring to bear upon the successful development and introduction of electric street railways. It is well-known that one of the greatest obstacles that have been encountered in applying motors, whether steam, compressed air, electrical or any other kind to the operation of street railways, has been the difficulty of securing sufficient adhesion between the driving wheels and track in wet or slippery weather, and especially so on railways having steep grades. In this respect cable and horse cars have heretofore had an advantage because of the application of the tractive force independent of the car itself, and, therefore, independent of the amount of friction or adhesion between the wheels and track rails. As the ordinary street car rails are necessarily level with the street surface, they do not permit of the same tractive effect as the elevated rails commonly used on steam and suburban railways, and it has, therefore, been possible to employ independent motors successfully only on roads having grades of less than 6 per cent., or a rise of 6 feet in a length of 100. In view of the fact that many street railway lines have grades of from 10 to 15 per cent. it does seem self-evident that some method of artificially increasing the frictional adhesion of the driving wheels must be employed before electricity can be successfully utilized as a motive power for operating street cars in our crowded cities on steep grades. In one of the model cars exhibited by Messrs. Ries & Henderson this increased adhesion is produced in a very simple and inexpensive manner by means of magnetizing helices or coils of wire on each axle, through which a current of electricity is passed whenever this additional tractive force is desired, as, for example, when starting a heavy load, or on going up an incline, or in case of a slippery track. So effective is this method that the car shown readily ascends a grade of 40 per cent., or 2,088 feet to the mile, by virtue of the magnetism induced in the wheels, and the peculiar arrangement of the magnetic circuit. The rolling motion of the wheels is not appreciably affected, and the amount of current required for producing this magnetizing effect is extremely small and insignificant when compared with the results obtained. The second model above referred to represents the operation as applied to steam railways. Instead of magnetism, a different arrangement is employed in which the molecular action of an electric current of large volume is caused to increase the frictional adhesion between the locomotive driving wheels and the track. This property of the electric current was observed, and its commercial importance pointed out by Mr. Ries, in a paper read by him before the American Association for the Advancement of Science, at the recent meeting in this city. In this system the locomotive is preferably provided with a small alternating machine, the current from which passes through a "converter" to give it the required volume, and this current is then led to the forward pair of driving wheels, which are insulated from the body of the locomotive. From these wheels the current enters the track and flows back to its source by way of the rear pair of driving-wheels, the arrangement being such that only that portion of the rails which lies between the two pairs of wheels is in the electric circuit. Consequently no danger from shock by coming in contact with the rails exists. The tractive effect is due to the molecular change and heat produced by the current at the point of contact between the wheels and rails, which causes a very decided increase in the coefficient of friction between the two surfaces, and prevents slipping or skidding of the wheels. The amount of current passing can be regulated by the engineer to suit different conditions of track and load, and it is claimed that an increase of from 50 to 100 per cent. in the tractive power of existing locomotives can be obtained with a very economical expenditure of current. If the performance of the model cars shown at the

exhibition can be equaled in practice, and there appears to be no reason why it should not, it goes without saying that an important advance in railway operation has been made that will almost immediately manifest itself by the impetus it will give toward the introduction of electric motors on street railways. On steam railways the greater speed obtainable due to the absence of slipping, and the heavier loads capable of being moved by the attachment of this simple apparatus to the present locomotives, will also prove of the greatest value.

Link Belting for Driving Dynamos.

While link belting has been used for the driving of machinery to a considerable extent abroad, its use in this country has, until recently, been quite limited on account of the flanged pulley required. This was necessary on account of the fact that the link as formerly made had its links all strung on a single rod passing through them, as shown in Fig. 1. The result was that when crowning pulleys were used but a small portion of the belt came in contact with the pulley, and slipping occurred. Hence where this form of link belting was desired, a straight pulley with flanged edges was necessary. But the friction of the belt against the flange introduced an objectionable factor, and that has militated against the introduction of the belt in America.

In order to obviate these difficulties and objections, there has recently been introduced by Mr. Ch. L. Ireson, of Boston, a form of link belt which seems especially applicable to driving fast moving machinery with small pulleys. The device by which the result is accomplished is exceedingly simple, and consists in making the belting in two or more longitudinal sections which are hinged together by their edges, as shown in two views in Figs. 2 and 3. If made in two sections the hinge rides over the crown of an ordinary cone crowned pulley. If, however, a round faced pulley be used, or the belt is of great width, it is usually better to make the belting in more than two sections, and give it more than one set of longitudinal hinges. By thus furnishing the belting with a series of longitudinal hinges the belt adapts itself to the crown of the pulley just exactly as an ordinary belt does.

This form of belt is said to be practically as strong as a double riveted or cemented belt, which has the same amount of frictional surface as an ordinary belt of the same width, and uses for its contact surface the edge of the leather, which is much less liable to slip than the surface of the leather on account of the fine velvet surface which is in contact with the iron. And in consequence of the fact that the belt is much heavier than the ordinary belt, a degree of slack may be given to the following side of the belt, which enables it to lap the small pulley on which it runs, and thus to obtain a friction surface on that pulley very much larger than where a tight belt is used.

A belt of this form was shown in operation at the recent convention of the National Electric Light Association in Boston. A Baxter six horse electric motor delivered with a three inch link belt its power to a countershaft, from which countershaft two four-inch common belts delivered the power to the shaft of a No. 6 Sturtevant blower, rated as requiring six horse-power. The link belt was so slack on the following side that in running from a five-inch pulley to a twenty-four-inch pulley, which were set about eight feet apart on the centres, there was a sag of about ten inches from the straight line which would have joined the highest points in the crown surface of the pulleys, the sag of the belt bringing the lower part of it within four inche

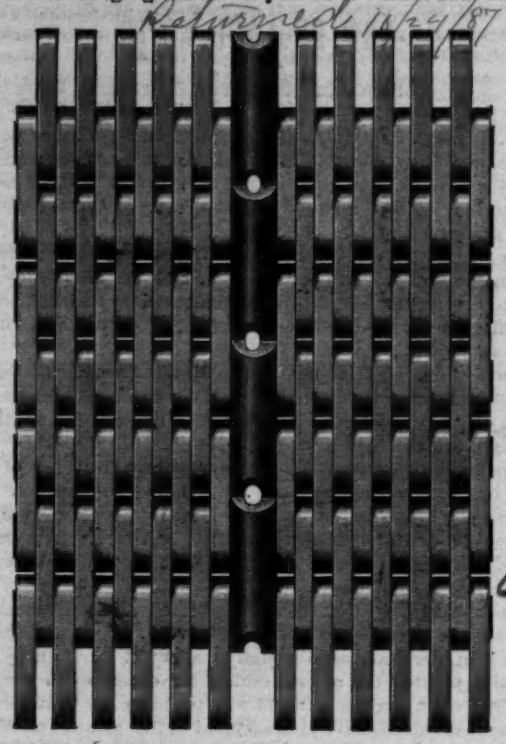
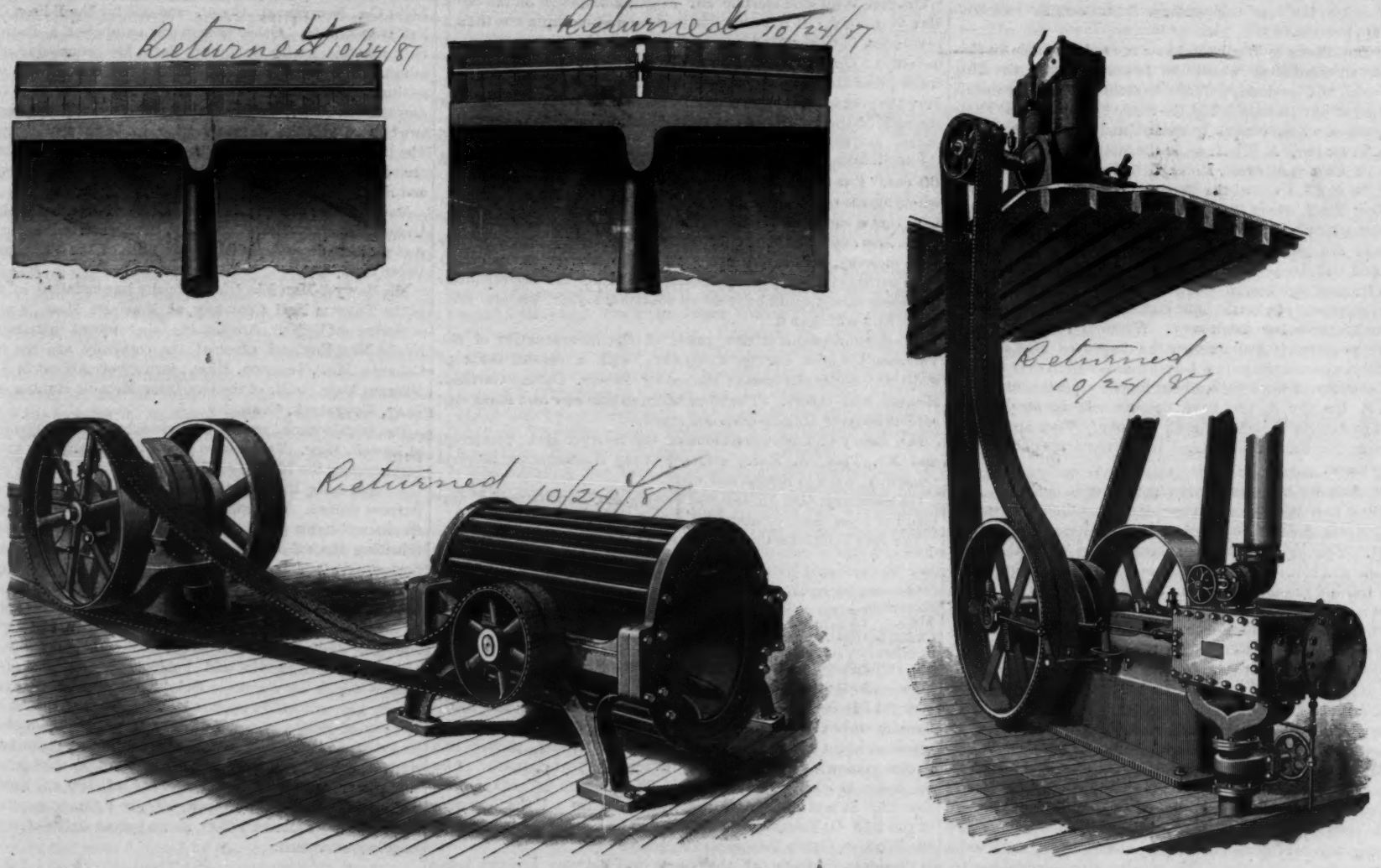


FIG. 3.

of the hauling side of the belt. In consequence of this sag the lap of the belt on the small pulley was more than a semi-circumference, while with ordinary belting this lap would have been somewhere from a quarter to a third of the circumference. As a result of this there was no slip, and a much narrower belt could be used than if frictional contact between the belt and the pulley had been required to be made by the width of the belt instead of by the length of the same.

In order to illustrate the manner in which these belts appear while running, we give in Figs. 4 and 5 two views, showing the same in different positions. The former shows a vertical belt now in operation in the Edison station in Boston, while the latter shows the belt running horizontally, attached to one of the Thomson-Houston dynamos in the Boston Electric Light Company's station. Both engravings give a very good idea of the increased friction circumference of pulley obtained by the slack of the belt which is made possible by the weight of the latter.



FIGS. 1, 2, 4 AND 5.—RUNNING DYNAMOS WITH LINK BELTING.

New York Fire Alarm Telegraphs.—Proposals will be received by the New York Board of Education until Oct. 26 for changes in the Board's telegraph circuits at the fire headquarters in East Sixty-seventh street.

Long Runs of Engines and Dynamos.

Now that electric light stations are becoming sources of supply by day as well as by night, and are required to keep up a constant outflow of current for motors between 6 A.M and 6 P.M., as well as for lamps during the hours of darkness, the ability of their apparatus to withstand the strain of long, continuous runs becomes a matter of prime importance. By and by perhaps this may not matter so much, but just now when electric light companies are beginning to feel their way into the power business it is a vital point; and we do not know that under any conditions it is likely ever to be less so. From time to time we have published accounts of patient continuance in well doing on the part of various plants, and now have to record another phenomenal run, made in Chicago by an Armington & Sims engine in an isolated plant there. Writing to the local agent of the engine, Mr. H. M. Kinsley, proprietor of a well-known restaurant there, says:

"In November, 1885, I placed two of your forty-five horse-power engines in my restaurant for the electric light system. Their record has been to me astonishing and I feel it due to you that I acknowledge the same. They have always been very satisfactory and a run made by one of them will, I think, surprise even you. It is as follows: Engine started July 24 at 9 o'clock A. M., and stopped Sept. 25, at 10:30 A. M., making a run of 63 days 1½ hours, or 1,518½ hours, 90,810 minutes, at 330 revolutions a minute; 29,967,300 revolutions. The engine was in perfect order when it was stopped except that it required a little keying up. The packing was as good as when it started; it drove a 250-light Edison dynamo with varying load of from 75 to 275 lights." Such a run, whether for engine or dynamo, is about as severe a test as one could well imagine, and brings to mind a similar run—which attracted much attention at the time made in 1883—when an engine of the same make, 14½×18, was put on a test at the Edison station in this city and was maintained in incessant operation for 16 days 17½ hours at 360 revolutions per minute, making a total of 8,431,500 revolutions. The lesson to be drawn from such performances is that electric lighting has exacted the utmost perfection of steam engineering and that the demand has been met. How much the good work of an engine means in easy, continuous running, with steadiness under all variations of load, no one but the electric light superintendent knows.

The Charleston Wires.—Much anxiety was caused on Oct. 15, when all the wires leading from Charleston, S. C., were cut. Another earthquake was feared, but it appeared after some hours that the interruption had been caused by a fire at the suburb of Magnolia.

The Sprague Car in Boston.—The new car of the West End Railway, supplied with electric motors, was tried yesterday afternoon (Oct. 10) on the tracks of the Cambridge Railroad, and proved a success. The car was started from the stables on Main street and run to the West Boston bridge, then switched off and run back to Harvard square, and then turned around and brought over, by way of Charles street, to the Mechanics' Fair building. There were forty-eight persons on board, but the motors carried them all up the heavy grades on Main street and Huntington avenue without the slightest difficulty. The curves were also rounded without any trouble.—*Boston Post.*

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Oct. 17, 1887.

A new material that has recently found its ready way into electrical work and appliances is indurated fibre, some of which, I note, can be seen at the electrical exhibition. This substance is a wood pulp prepared in about the same way as for paper making. Its absolute non absorbent quality is one of its chief points of excellence in some of the countless articles into which it is made. So durable is this peculiar material that it is being made into gas, water and electric pipes, some of which are used in the subway now being laid in this city. In addition to a Portland, Me., establishment, the Union Indurated Fibre Company, making the fibre, have factories in Skowhegan, Me.; Watertown, Mass.; Mechanicsville, Oswego, nd Lockport, this State, and Winona, Minn. About 1,500 operatives are employed, which are under one management, and nearly $1,000,0000 is invested in the enterprise. The company's offices in this city are at 110 Chambers street. The subway tubes above mentioned are expected to give first-class results, and the material can also be made into storage cells, battery jars, and the like. It is not affected by changes in temperature, nor by battery acids, and in cold weather solutions do not freeze to it. Some of the concerns now employing it are the Hub Carbon Company, Boston; the Electrical Accumulator Company, of New York; the Julien Electric Company, of New York the Electric Storage Company, of Baltimore; the Woodward Accumulator Company, of Detroit; the River and Rail Electric Light Company, of this city.

No name is more prominently identified in this country with electro-medical apparatus than that of Jerome Kidder, and at the present time no instruments are better known here and abroad than those of the Jerome Kidder Manufacturing Company, whose exhibit at the American Institute Electrical Exhibition stands to-day as an exponent of the great improvements made by the concern whose beginnings now date back well nigh a quarter of a century. The company has just issued its latest catalogue, which has reached the respectable and even striking total of 118 pages. The catalogue embraces a variety of highly interesting matter, and furnishes the public with useful data on the subject of electro-therapeutics in all its branches. A noteworthy section is that devoted to the opinions of the medical men of standing who have tried the apparatus in the daily practice of their profession, and who have found it all that could be desired. Another part of like nature quotes a number of medical opinions and statements with regard to the use of electricity in the treatment of disease. All the various apparatus of the company, and the methods of using it, are fully described, and the catalogue is, taken altogether, the best compendium extant on this branch of electrical application.

Messrs. Tewksbury & Wonham have opened an office in this city under circumstances which the following from the Hill Clutch Works, of Cleveland, O., fully explains: "We beg to call the attention of our customers and the trade to our general Eastern office, which we have recently opened under the management of Messrs. Tewksbury & Wonham, in the Metropolitan Telephone Building, 18 Cortlandt street, Room 510, New York City. The office will be at all times at the disposal of our customers when visiting New York, where they will be assured a cordial welcome and the best attention from our managers. Messrs. Tewksbury & Wonham are gentlemen of large experience in this line of business, and will be pleased to give any information desired in regard to friction clutches, to submit plans and estimates for the complete equipment of electric light stations, mills, factories, etc., with power transmission machinery. With our increased facilities we are prepared to manufacture the improved Hill friction clutch pulleys and couplings in a better manner than ever before, and to guarantee all work we send out in every particular."

The E. S. Greeley & Co. have become sole agents for the Cleveland switch for New York and vicinity. They are having a large sale for the "electricians' tool," recently put on the market by them.

It is not often one sees foreign dynamos in this country. One lately arrived is a big Elwell-Parker machine, which now stands on the salesroom floor of the Empire City Electric Company, in Dey street. You have already illustrated this dynamo, which is well made and looks capable of high output. The company are are very actively engaged on their dynamo gas lighter, which they have lately improved, and for which the demand is steadily brisk. They are adding a number of novelties to their stock.

No demand is more on the increase than that for electrical test instruments and the man that considers himself an electrician is ashamed unless he knows their principles and is familiar with their use. The Electrical Supply Company, of 17 Dey street, have a very large stock now for all conceivable purposes, and can fill at once orders for the standard instruments of Ayrton & Perry, Elliott Bros., Carpentier, etc., such as ammeters, voltmeters, rheostats, Wheatstone bridges, galvanometers, photometers, in every variety. In other lines may be mentioned their new Leclanché open circuit porous cup battery. The company are also manufacturers of gongs, bells, etc., cast or spun, with wood or iron bases, box or skeleton. The gravity drop annunciator introduced by the house is also in extensive use.

Hazazer & Stanley, 32 and 34 Frankfort street, showed me last week a very handsome style of electric letter boxes, eight in number, set parallel in plain bronze. The firm are closing up some big contracts on hotels in this city and neighborhood. This is a class of work to which they give special attention.

Chas. A. Schieren & Co. report sales of leather link belt to the following parties: Jas. Bancroft & Sons., Wilmington, Del.; Edison Electric Illuminating Company, Brockton, Mass.; Edison Electric Illuminating Company, New Orleans, La.; Chicago & Alton R.R. Company, Chicago, Ill.; Van Choate Electric Light Company, Boston, Mass.; Marietta Chair Company, Marietta, Ohio; Orrs & Company, Troy, N. Y., second order; Reed & Company, 88 Wall st.; Sprague Electric Motor Company, American Institute Electrical Exhibition; Herkimer Paper Company, Herkimer, N. Y., second order; Barrett & Son, Spring Valley, O.; Benedict & Burnham Manufacturing Company, Waterbury, Conn., second order; J. D. Jones, East Bridgewater, Mass.; J. Linck & Company, 519 W. 19th street, city; New Bedford Electric Light Company, New Bedford, Mass.

I note that the National Electric Service Company, of 120 Broadway, owning the Johnson heat regulating apparatus, are organizing sub companies throughout the country. Mr. W. C. Temple is at the head of the New York Company, called the Metropolitan. Several big companies have been organized, and capital is interested, but I hear that no contract has yet been made for Massachusetts. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Oct. 17, 1887.

Mr. Cyrus O. Baker, Jr., of the firm of Messrs. Baker & Co., platinum refiners, Newark, N. J., has been in Boston on a business visit for several days past. Mr. Baker has a host of friends among the electrical fraternity, and consequently has a pleasant time wherever he goes.

The Committee on Underground Wires, appointed some time ago by the Boston Board of Aldermen, met on Wednesday, Oct. 12, to consider three reports on its recent trip to Philadelphia and Washington relative to the best method of laying wires underground.

Morris Fox, of Danbury, is doubtless the youngest telegraph operator in the service. He is twelve years old, and began work when only nine. He is an expert, and will soon take a position in the main office at New York City.

The Tropical American Telephone Company, Limited, of Boston, has received applications for aid and co-operation from parties who have secured exclusive concessions to operate telephones in four different sections of its territory. Any one inclined to invest in foreign telephone business would do well to write and get particulars.

An exchange says that the dividend rate on Erie telephone will probably be increased to 3 per cent. Nov. 1. The earnings have for a long time been large enough to allow of such an increase and still provide for a good outlay for construction purposes. The date of paying the dividend will probably be changed also. Hitherto dividends have been declared in the months of March, June, September and December, and have been payable in the succeeding months. Hereafter the declaration will be made about the first of November and at quarterly intervals therefrom, payable about the middle of the same month. The directors have just returned from inspecting their Cleveland and Northwestern divisions. They express themselves highly pleased with their condition and satisfied that the $50,000 spent upon reconstruction in St. Paul and Minneapolis the past four months was well invested.

I take the following from the Boston *Transcript* of Oct. 11: "The first West End electric car caused a sensation on the Back Bay yesterday. It is a complete success, and nothing less than a revolution in railroading, one of the greatest in our day of great novelties. Only the rails were to blame when it once ran off the track; and and then it promply helped itself on again, running over the cobble-stones or around curves with perfect ease. The strength of the motor is something incomprehensible to the uninitiated, and really astonishing, considering how small a space it occupies—only a foot square around the axle under the bottom of the car. But the batteries supplying the electricity extend the whole length of the car under the seats, and they raise these so high that a step up is required from the platform, which trips one up on first entering the car But there is no doubt, practical railroad men say, that horses are soon to be forever emancipated from car service and perhaps steam, too. Had the Metropolitan had these cars it could have saved $500,000 a year, we are told. West End will save it."

The announcement is now made of the incorporation of the Thomson-Houston Carbon Company, with a capital stock of $250,000, under the laws of Maine, by Messrs. Coffin, Garfield, Hosmer and others. The steps taken in this new and important enterprise have already been described.

Mr. Henry C. Davis, president of the Sawyer-Man Company, and Mr. Thos. B. Kerr, attorney of the Westinghouse Electric Company, were in Boston last week.

On Saturday, Oct. 15, the Bell Telephone Company paid a dividend of 3 per cent., or about $300,000.

The Erie Telephone Company makes the following statement:

	August, 1887.	August, 1886.	Five mos. 1887.	Five mos. 1886.
Gross earnings	$52,136	$43,937	$248,127	$218,278
Expenses	35,142	28,841	166,606	145,232
Net	16,993	15,095	81,521	73,045
Construction	5,029	3,179	17,157	11,070
Surplus	11,964	11,915	64,364	61,975
No. subscribers added	87	93	572	223

It has been rumored on the streets of Boston for several days past that an order has been issued to close all offices of the Baltimore & Ohio Telegraph Company, but inquiry at the office of the superintendent and cashier, on Arch street, Boston, proved this rumor to be without foundation. It must have originated from an order to close all accounts at 12 o'clock on Saturday night, Oct. 15. It was stated also that "in the future all the accounts of the B. & O. Telegraph Company will be kept in the interests of the Western Union Telegraph Company."

President Whitney, of the West End Railway, arrived home yesterday, and last evening took a run on the new motor car. He expresses himself as highly pleased with the results and believes that sufficient speed will be obtained. The car jumped the track once, and it was then ascertained by measure that the track at that point was two inches out of gauge. The several companies will be consolidated about Nov. 1, and possession taken by the West End Railway Company. Of the stock, 38,000 out of 40,000 shares of Metropolitan, 19,000 out of 19,500 shares of Cambridge, 15,180 out of 17,000 shares of Consolidated and 14,500 out of 15,000 shares of South Boston have come in for exchange, leaving less than 5,000 shares outstanding.

Some weeks ago a nervous citizen of Newton, Mass., made a complaint to the authorities of that city that his family was disturbed at night by the jarring and noise of the engines of the local electric lighting station which is adjacent to his residence. The Mayor appointed a committee to investigate the matter, and it was ascertained that there were no just grounds for the complaint. Among the tests made to ascertain if there was any jarring as alleged by the complaint, nickels and lead pencils were repeatedly—and successfully—stood upright on the cylinders of the Armington & Sims engines. The Newton Electric Light Company is so well pleased with its plant and the result of the investigation of the committee that an order has just been given the Jarvis Engineering Company to increase the steam plant equipment of the former's station.

On Saturday evening, Oct. 15, the Hyde Park, Mass., Committee on Electric Lights voted 11 to 9, to notify the American Electric Manufacturing Company, of New York, to furnish electric lights of not less than 2,000 candle-power, as per contract recently awarded.

The Thomson Electric Welding Company has nearly completed its building at Lynn, Mass. It will be equipped with a complete line of machines and tools, with an office and accomodations for the company's draughtsmen.

Reports from Woonsocket, R. I., regarding the running of the electric car under the Bentley-Knight system and using the Thomson-Houston motor, state that the projectors of the enterprise are highly satisfied with results thus far demonstrated by the car. On Sunday, Oct. 9, the car carried about 1,000 passengers, making its trips in one-third the time consumed by the horse cars over the same line. Some of the grades on the Woonsocket road are in places as much as 7½ per cent., yet the electric car passes up and over them with perfect ease. The curves on the same road are very short, yet do not interfere in any way with the working of the electric car.

The Jarvis Engineering Company, No. 61 Oliver street, Boston report business as brisk in all their agencies. They have recently closed a contract to erect a steam plant for the Somerville Electric Light Company, of Somerville, Mass., including two Armington & Sims engines, setting two steel tubular boilers with the Jarvis patent boiler setting, and Sheffield grates, heater, Korting injector, piping, etc., and erecting a new style of brick chimney. This will be a model electric light station. They will erect an electric light station for the Westboro Electric Light Company, Westboro, Mass., also a new station for the Webster Electric Light Company, Webster, Mass., consisting of an Armington & Sims engine and a tubular boiler with the Jarvis setting; South Framingham Electric Light Company, using two Armington & Sims engines and a boiler with the Jarvis setting to burn screenings for fuel; Lawrence Gas & Electric Light Co., Lawrence, Mass., two Armington & Sims Co. engines and two boilers set with the Jarvis setting to burn coke and coke screenings. The company are also setting 1,200 h. p. of Heine safety boilers for the Boston Steam Heating Co., and 1,000 h. p. of Heine boilers for the Edison Illuminating Company, Boston. They are also erecting a station for the Bridgeport Electric Light Company, Bridgeport, Conn., including two Armington & Sims engines, and setting three tubular boilers with the Jarvis setting. Another Armington & Sims engine is required for the New Haven Electric Light Co., New Haven, Conn., and one for the Edison Company, Fall River, Mass. Other new work comprises a station for the Bath Electric Light Company, Bath, Me., consisting of two Armington & Sims engines, and setting two boilers with the Jarvis setting; erecting a station for the Thomson-Houston Company, Jamestown, N. Y., setting two Armington & Sims engines and two boilers with the Jarvis setting to burn screenings for fuel. The Brush Electric Light Company, of Boston, Mass., have given the order to set the ninth tubular boiler with the Jarvis setting and Sheffield grates to burn screenings for fuel.

Messrs. Paine & Francis, New England agents of the Edison United Manufacturing Company, have received an order to install an incandescent plant in the mill of the Fitchburg, Mass., Paper Company.

The Sawyer-Man Electric Company has installed in the works of the Putnam Nail Company, at Neponsit, Mass., a plant of 80 incandescent lights. Among the other recent installations made by the New England office of the company are the following: Cohanet Mills, Taunton, Mass.; factory of Abbott & Co., Forge Village, Mass.; mills of the Goodyear Metallic Rubber Shoe Company, Naugatuck, Conn.

The textile machinery and fabric exhibition opened on Oct. 13, at Lowell, Mass. The motive power for running the machinery is furnished by the Middlesex Electric Light and Power Company, of that city, using the excellent Thomson-Houston motors for the purpose named. The same company is furnishing also arc and incandescent lights (both systems being Thomson-Houston) for illuminating the exhibition building, and, naturally, the plant gives perfect satisfaction.

The gas commissioners have passed the following order upon petition of the Brookline (Mass.) Gas Light Company for authority to engage in the business of generating and furnishing electricity for light and power: "Ordered, that said company is hereby authorized to engage in said business in that part of the city of Boston which was formerly Brighton wherever it is authorized to supply gas, and in the town of Brookline, and also in so much of the city of Boston as was formerly part of the town of Brookline; and that said company, within six months from this date, procure a plant, erected and equipped for generating electricity for light and power, with a minimum capacity of 180 arc lights of nominally 1,200 candle-power each, 100 arc lights of nominally 2,000 candle-power each, and 300 incandescent lights of nominally 16 candle-power each." W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., Oct. 17, 1887.

The Baltimore & Ohio telegraph transfer to the Western Union is still, as it has been for sometime past, the all-absorbing topic of conversation and discussion among telegraph men and financial sharps in this city. The story published in the New York *Herald* of the 11th inst., that Mr. Gould in purchasing the B. & O. lines did not take the action merely for the sake of securing additional telegraph wires or facilities—which the Western Union do not need—but to obtain a listing of Western Union stock on the London Stock Exchange, by reason of his having been associated in the negotiations which led up to the final transfer with the undoubtedly strong and respectable house of Drexel, Morgan & Co., has received considerable attention at the hands of brokers and financiers generally. In referring to this matter, the *Record* in a recent issue says:

The syndicate now in control of the Baltimore & Ohio Railroad Company, and which sold the Baltimore & Ohio Telegraph Com-

pany to the Western Union Telegraph Company, denies most emphatically that it is in any way interested in making a market for the stock of the Western Union Telegraph Company either here or in London. A prominent member of the syndicate, after reading a report from London to the effect that the syndicate had purchased a large amount of the Western Union stock, made the following statement:

"It has been customary from time to time to intimate that what is known as the Drexel-Morgan syndicate has taken part in all the important reorganization schemes for purposes of speculation. This is absolutely untrue.

"The sale of the telegraphic rights and properties of the Baltimore & Ohio Railroad Company was nothing more than a part of the negotiation with Mr. Garrett. The telegraphic branch was an unprofitable part of Mr. Garrett's great system, and it was decided that it should be sold, and the sale was intrusted to the syndicate. Considerable has been said in condemnation of the sale having been made to Mr. Gould. There was no understanding between the parties in interest as to whom the property should be sold to. There was only the one understanding, and that was that the property should be sold. There was but one bidder, and that was Mr. Gould. Efforts had been made to get up syndicates to purchase the property, but these all failed, and there was nothing left to be done but to let Mr. Gould have it. The syndicate has taken no partnership interest with Mr. Gould in his stock or in any other way, and has merely recognized him in the transaction as it would any other customer for the property".

The recent visit of Mr. Joseph J. Walton, of the firm of James W. Queen & Co., to the various countries of Europe, has resulted in an immense increase of business to the firm. During his absence Mr. Walton secured the sole agency for the United States of the instruments manufactured at the celebrated factory at Glasgow where Sir William Thomson's work is done, and of the new style spring ammeters and voltmeters of Ayrton and Perry. The superiority of the latter instruments over those formerly made under the same name consists in their being dependent upon a spiral spring instead of a magnet, which was found to be a serious drawback to their use by reason of the magnet losing its power when being placed near a dynamo or other instrument of great magnetic strength. In the old type of their permanent magnet and spring instruments, the pointer pointed to a certain number of degrees on a scale, the electrical value of which had to be ascertained either by multiplying by some troublesome constant, such as 1.87, or by referring to a table of values. In all their new direct reading instruments, throughout the whole range of the scale, the pointer points at once to the exact number of ampères, volts, etc., to be measured. No multiplier or table of values is needed, and no permanent magnet is employed.

The instruments of Thomson, and Ayrton and Perry are all of new design, and are all tested and certified to before being shipped to this country, thus giving purchasers a guarantee, over the signature of the maker, as to their reliability. The electrical business of Messrs. Queen & Co.'s establishment has increased to such proportions that it has been found necessary to form a separate department for the handling of this class of goods, known as "Department 4," under the immediate supervision of Mr. Walton. Electricians and others interested in the science of electricity will do well to apply for the new catalogues of Messrs. Queen & Co., which are now in the hands of the printer, and will soon be ready for distribution.

At a meeting of the Board of Directors of the Philadelphia Time-Telegraph Company held at No. 319 Walnut street, Crawford Spear was elected a member of the board. George M. Brill, the president of the company, then resigned to accept the vice-presidency, and Mr. Spear was appointed to fill the vacancy. The board consists of Crawford, Spear, George M. Bull, Gustav Stahl, Celto Fleming, C. John Hexamer, and Hans Weniger.

"The popularity of the electric light is astonishing," remarked Select Councilman Graham, chairman of the Electrical Committee of Councils, one day last week. "We have already ordinances asking for the location of six times more lights next year than there will be appropriations for. I can't conjecture how much larger the disproportion will be. I think members of Council should exercise some discretion in the matter. It is ridiculous to ask for a dozen lights when it is well known only one can be located."

A dispatch from London was published last week stating that the London *Times* had received a special dispatch from Tien-Tsin saying that the Chinese Government had formally withdrawn the American Bank concessions, and it caused considerable of a sensation among financial men and others who had pinned their faith to the scheme. Wharton Barker still insists that no such action could be taken without the consent of his syndicate, and he declares that if the scheme were to be repudiated by the Chinese Government at this stage of the proceedings he should call upon the United States Government to uphold him in his position. However, he says, he does not fear any such action, and he thinks it would be strange if any such stop had been made without notifying either the special Chinese Envoy, who accompanied Count Mitkiewicz on his return to this country, or the Department of State at Washington. Besides, he feels very confident of his position since receiving Secretary Bayard's reassuring letter stating that no notice had been received by the government of an intended backdown by the Chinese. Other members of the syndicate talk in a similar strain. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Oct. 15, 1887.

The absorbing topic of the past week has been the fight in the council over the Gas Trust. The entire city lighting is practically in the hands of this consolidated company, and the recent action of the City Council in declaring void the franchises of two of the companies forming the Trust announces the beginning of what will probably be a long and expensive litigation. Meanwhile, the progressive members of the council are working upon plans for lighting the city by electricity.

Alderman Manierre, who is the leader of the opposition against the Gas Trust, favors utilizing the lamp-posts and installing incandescent lamps of a high candle-power.

Prof. Barrett is already hard at work upon several schemes which will be brought before the proper committee. The tower system of Detroit does not seem to find favor among the councilmen.

President Wright, of the Chicago Board of Trade, has closed up the Commercial Quotation Company, of Chicago. This company has been furnishing quotations at two dollars per week instead of ten dollars, the old rate of the Western Union Company.

I learn from Mr. L. B. Parker, general superintendent of the Postal Telegraph Company, that Mr. Wright gives as a reason for shutting off the quotations to this company that the parent company in New York, of which this is a branch, had been furnishing the New York Produce Exchange quotations in Boston. The open board is practically closed, and the "bucket shop" thrives as of yore.

Mr. J. H. Reid, agent for the Mather Electric Company, has returned from the Northwest. Mr. Reid has contracted for a 600-light plant for the Mortimer Apartment House, of Minneapolis, and 500 lights for the Frank P. Blair Apartment House, of St. Paul.

Happening to call upon Mr. Tausig the other day, while he was opening his mail, I was shown several orders for the well known "Synovial" dynamo oil from outside points, and the award of the government contract for supplying the Custom House and Post Office for the ensuing year. Mr. Tausig secured this latter contract last year, and the renewal of the order this year at an advance over competitors is of itself evidence of the superior and uniform quality of his oil.

Mr. W. C. Hayes, treasurer of the National Carbon Company, was in the city this week. Mr. Hayes is on his way to Colorado for recreation.

The following dispatch has been received from Indianapolis: The suit brought against the Central Union Telephone Company by Attorney-General Michener in behalf of the State for unpaid taxes for six years and for the penalty imposed for refusal to make an annual report to the State has been dismissed in the Circuit Court in Indianapolis. The company submitted reports for the years not covered and paid in full the taxes due from them, amounting to $1,641.25. It would have been possible to have collected the penalty for the failure to report, but after the taxes had been paid and the reports submitted there was no disposition on the part of the Attorney-General to push the suit further. His demand was for $40,000.

Mr. John R. Markle, Michigan manager for the Edison Electric Light Company, recently returned to Detroit from Sault Ste. Marie, where the Edison Company is firmly establishing itself. "So much land on the water front is owned by the local Edison Company," said he, "that we can control the water-power until the proposed $1,000,000 canal is built. We are building a smaller canal and have 300 men at work on it. Ten thousand lights will be put in the town. With free water-power we are going to make electric light so cheap, and supply power by dynamos so reasonably, that no one within a radius of five miles can afford to burn oil for lighting, or coal for manufacturing purposes. This last feature will make the plant permanent and valuable after the big canal is done. Manufactories can be erected on cheap land away from the canal, and what would be saved in the price of the lot will pay for the electric power."

The Brush Company at Detroit have finally decided to put their wires underground within the half mile circuit. The death occurred on Monday evening of a Brush electric line man, while on a pole adjusting a cross. It was suggested by one prominent in electric circles that it should be compulsory to use a pressure of 1,000 volts instead of 3,000 to avoid such accidents, which would necessitate the stringing of more wires at the cost of $25 per mile for each circuit.

The Canadian Electric Company are to use the Woodward storage battery, and push it for all it is worth throughout the entire Dominion. Under Professor Woodward's supervision they are manufacturing in London, England, 24 primary and 24 secondary batteries for test in Toronto, where they propose to establish their headquarters. They will begin operations in about a month. This company is a strong one, being composed of some of Detroit's best business men, with their capital stock of $150,000 paid in. The officers are: President, A. E. Lavitt; vice-president, Robt. McKinstry; treasurer, J. W. Weeks.

The following has been received from St. Catherines, Ont.: The St. Catherines Street Railway opened their six miles of road between this city and Thorold to-day. It is run by electricity, and proved a perfect success in every particular, far exceeding the expectations of the managers. The system adopted is known as the Van Depoele. The electricity, which is generated by water-power at Lock 12, Welland Canal, with a large dynamo, is conducted by overhead copper wires connecting with the cars by means of small wheels which run along on the wires and thence through a flexible conductor. The cars are equipped with a 15 horse-power motor weighing about 1,600 pounds, which is placed on the front platform. The people are enthusiastic over its success. The company expect to have twelve motor cars on within two weeks. The time of traveling between this city and Thorold has been reduced twenty minutes. The cars are under perfect control, being stopped and started without any jerking motion, going around curves of forty degrees and up grades of 7 per cent. without the least difficulty.

My St. Paul correspondent writes:

The Thomson-Houston, Sawyer-Man and Westinghouse combined Companies have opened an office in St. Paul, with Messrs. Gilman and Daigh agents for the Northwest.

A new company has been formed here for construction and repair work, and already reports nearly fifty men at work. It is called the Northwestern Construction and Supply Company.

The telephone list at St. Paul has increased so rapidly of late that the employés' list has trebled within a year. The service is excellent, for which Mr. Yensen, the manager, deserves much praise.

The Edison Company are now serving about 7,300 lights in St. Paul, and if certain extensions which are under consideration are made, the capacity will be increased to 20,000 lights.

The electric railway at South St. Paul is almost completed, and will be running in a short time.

A large mileage of cable lines is being laid in St. Paul and the work is kept up all night by means of temporarily erected electric lights.

The Hawkeye Electric Co.'s system is meeting with much favor in this section. Mr. Bowen, the general manager, was in St. Paul recently, and remarked to your correspondent that he had sold within the past five days four plants of 100 lights each.

I learn that the Thomson-Houston agency of St. Paul have just put in operation 450 incandescents and 100 arc lights at Fargo, Dak., and 500 incandescents and 30 arc lights at Faribault, Minn., besides a 50-light incandescent plant in a residence at Prairie du Chien, Wis., run by a windmill. Mr. Gilman, agent, states that the consolidated companies will shortly commence building operations for a plant with a capacity of 100 arc and 3,000 incandescent lights at St. Paul, using the Westinghouse system of incandescents.

From New Orleans I have the following items:

The subjoined communication was presented to the City Council last evening for consideration and approval of that body before acceptance of bids for lighting of the public buildings of this city by electric light. Gentlemen: It has been stated on the floor of the Council chamber by Alderman Moon that the cost of securing the electric light plant which this company offered to install in your institution would exceed the cost of gas consumed by same. Not wishing to question the statement, and desirous of avoiding a controversy in a matter of this character, we now propose to your honorable body in lieu of our original offer the following: To wire your buildings, place lamps wherever gas jets are at present, and to supply the current direct from our plant, thus entailing no expense upon you. We, however, still hold to our original proposition made to the City Council, should you conclude to accept the same. Respectfully yours, JOSEPH SIMON,
President Louisiana Electric Light and Power Company.

The Great Southern Telephone Company, of this city, has entered suit against the Guarantee Company, of Baltimore, to recover on the bond of Philip Baker, former telephone manager at Jackson, Miss., who was short in the sum of $1,500.

A dispatch from Memphis of Oct. 5 says: All during the day the telephone manager has been kept busy receiving notices from subscribers to take out their instruments, but in no instance has the company removed them. Several hundred notices were served, and by to-morrow night over 1,000 of their subscribers in Memphis will have given official notification for the company to take out their telephones. The feeling against the company is becoming more intense, and when the committee appointed complete their plans for the establishment of a new company the stock will be promptly subscribed. The merchants and citizens of Memphis are determined to stand firm against the demand of the company for an increase in rental. This question will be settled by the next Legislature, and no man can be elected from this county who will favor allowing rents for telephones to exceed $4 per month.

I note the following incorporations:

The Peoria Heat, Light & Power Company of Peoria, Ill.; capital stock, $50,000; object, to furnish heat by steam and light by electricity; incorporators, Joseph B. Smith, Eliot Callender, S. H. Thompson, R. S. McDonald.

The Electrical Hatchway Door Company of Chicago, capital stock, $200,000; object, granting licenses and selling territory on any devices owned by the company; incorporators, C. F. Banks, R. L. Webster, M. F. Holmes.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me with the following quotations upon telephone stock:

Bell of Mo	$155@$157
Central Union	44@ 45
Chicago	385@ 400
Colorado	18@ 20
Cumberland	80@ 85
Great Southern	28@ 30
Iowa Union	25@ 27
Michigan	72@ 73
Missouri and Kansas	68@ 69
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

C. H. M.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Sight Feed Lubricators.—Mr. F. Lunkenheimer, of the Cincinnati Brass Works, announces that "with the exception of one or two persons previously licensed," he has obtained from the Seibert Cylinder Oil Cup Company an exclusive license, under the sight feed lubricator patent, to make all sell lubricators everywhere in the United States, excepting New England.

Water Tube Boilers.—The National Water Tube Boiler Company, of New Brunswick, N. J., have taken, among their orders for last month, a contract from Messrs. Church & Company, soda ash manufacturers, of Greenpoint, L. I., to furnish them with a boiler of 100 horse-power (Moore's patent), which they will send to the Western part of the country, to be erected at a mine. These boilers are specially adapted to this class of service, as they are shipped in packages or pieces of such a size as to be easily transported and erected in positions where it would be impossible to place a tubular boiler. Messrs. Church & Company have 165 h. p. of these boilers in their Brooklyn factory, which having proved thoroughly satisfactory, led them to place their order as above.

The Shaw & Geary Electric Buzzer.—This instrument, made by the well-known Philadelphia firm, is intended to give a quiet signal in places where an electric bell is not desired. The tone produced is low and measured, similar to the buzzing of an insect. The difficulty experienced in the manufacture of buzzers heretofore was the failure to keep in adjustment. This and other defects have been overcome in the Shaw & Geary buzzer by the use of suitable metal contacts, which resist magnetism. The adjusting screw is so delicate that a half tone can be produced. The cases are 3½ inches in diameter and 1⅛ inches high, turned from several varieties of wood, highly polished, with nickel plated screws for fastening to wall or desk in any position. The contact points are so made that the buzzer can be operated with one or six cases of battery without altering the adjustment.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

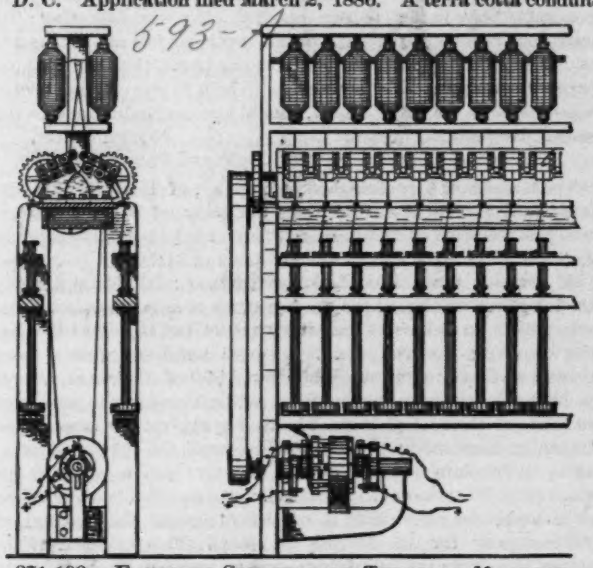
PATENTS DATED OCTOBER 11, 1887.

371,161. Insulating Clamp for Electric Conductors; T. E. Adams, Cleveland, O. Application filed July 11, 1887. A device for attaching a binding post to a metallic plate so as to thoroughly insulate the two, consisting of a flexible washer which is forced up into a cavity on the underside of the plate by the screw, which holds the post in position.

371,189. Voltaic Inner Sole; G. A. Fullerton, Boston, Mass. Application filed April 7, 1887. Rings of positive and negative metals are arranged to lap over each other, and the whole is threaded by a strip.

371,199. Electric Spinning or Twisting Machine; A. S. Kimball and G. L. Brownell, Worcester, Mass. Application filed June 8, 1886. A series of spindles in combination with a series of electro-motors, the current to which is regulated by a commutator rotated independent of the mechanical resistance of the revolving spindles. See illustration.

371,202. Electric Wire Conduit; J. Lynch, Washington, D. C. Application filed March 2, 1886. A terra cotta conduit



371,199. ELECTRIC SPINNING OR TWISTING MACHINE.

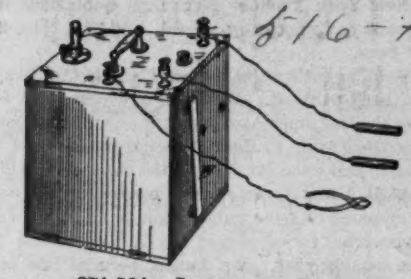
formed in two vertical sections, one of which is divided into compartments and the other closes over the face of the same.

371,241. Telephone System and Apparatus; G. T. Woods, Cincinnati, O., Assignor to the Woods Electric Company. Application filed June 1, 1885. The system consists of a local battery circuit having a loop, a variable resistance shunt interposed between the bifurcations of the loop and controlled by the receiving diaphragm, and an induction coil having its primary interposed between the ends of the loop and centrally connected back to battery.

371,244. Primary Battery; M. Bailey and John Warner, London, England. Application filed Dec. 29, 1886. A porous cell is ready charged with a paste of plumbago, nitric and sulphuric acids in about the proportions of one pound plumbago to a half pound each of the acids.

371,253. Electric Locomotive; L. Daft, Plainfield, N. J. Application filed Sept. 5, 1885. The bearings of the motor are mounted on cushions which take up shocks incident to the "hammering" of the wheels upon the track. For description see THE ELECTRICAL WORLD, Sept. 5, 1885.

371,256. Apparatus for Forming Sheet Metal by Electro Deposition; E. Emerson, Providence, R. I., Assignor to the Rhode Island Copper Co. Application filed Oct.



371,524. INDUCTION COIL.

11, 1886. The cathode in the form of a cylinder is rotated in a bath containing the anode and the metal is deposited in a sheet on the cylinder.

371,260. Telephone Switch; W. M. Goodridge, Highland Park, Assignor to the Western Electric Co., Chicago, Ill. Application filed March 21, 1887. The object is to avoid the use of the special retractile springs in connection with gravity switches.

371,331. Apparatus for the Transmission of Electrical Energy; G. Kornmueller, Ghent, Belgium. Application filed Jan. 8, 1887. The invention is designed to render the periods of interruption long, even while the contacts and the attractions remain rapid and short, in vibrating circuit breakers.

371,336. Means for Supporting Overhead Conductors; G. W. Mansfield, Cleveland, O. Application filed May 20, 1887. The posts are provided with trusses which support the conductors at points remote from the post, thus lessening the number of posts. See illustration.

371,356. Electro-Therapeutic Belt; W. L. L. and W. J. Pierce, San Francisco, Cal. Application filed March 11, 1887. Strips of different metal are bent together so to form links, each link being connected to the other by a strip attached to opposite metals.

371,358. Secondary Battery; A. Reckenzaun, London, England. Application filed July 14, 1887. The active material is forced into molten lead, and the latter allowed to cool to form the electrodes. See THE ELECTRICAL WORLD, Oct. 8, 1887.

371,406. Plastic Composition for Insulating Electric Wires; W. W. Barnes, New York, Assignor to B. C. Kirk and T. T. Taber, of Glen Cove, and W. A. Miller, of Oyster Bay, N. Y. Application filed March 10, 1887. Mineral coal and sulphur are fused together to form an insulating compound.

371,436. Method of and Apparatus for Starting Electric Motors; Leo Daft, Plainfield, N. J. Application filed Jan. 5, 1887. The method consists in closing the circuit of the generator both by the series and shunt coils of the field, and then cutting the series coil out of the circuit.

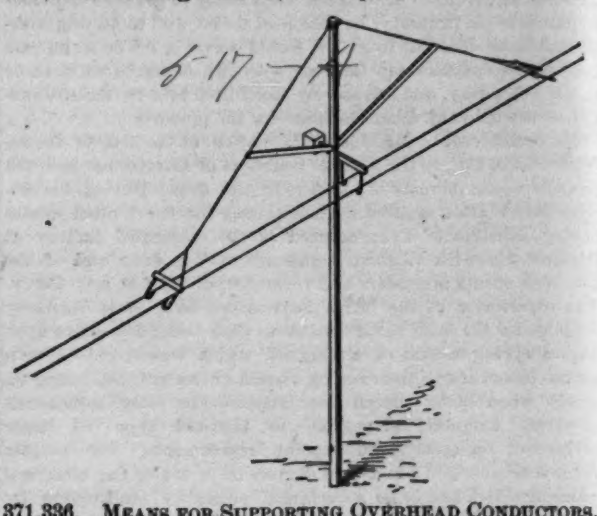
371,439. Mechanical Telephone; W. H. Eastman, Concord, Assignor to F. R. Butterfield, of same place, and A. J. Lane and A. Elliott, Manchester, N. H. Application filed Jan. 17, 1887. Small diaphragms connecting with a sound passage are arranged around the speaking diaphragm, and they are all connected to the line wire by branch wires.

371,443. Reversing Mechanism for Electric Motors; F. E. Fisher, Detroit, Mich. Application filed Dec. 13, 1886. The brushes extend on each side of the holders and the holders may be rotated so that each brush may be made to impinge on both sides of the commutator.

371,445. Electric Signaling Apparatus; W. Glasgow and S. S. Stevens, of Chicago, Ill., Assignor to the Combined Electric and Trip Bell Cord Co. Application filed Sept. 29, 1886. Structural details whereby a bell in the cab of a locomotive is prevented from jingling due to the jarring, also to enable the engineer to signal the conductor.

371,521. Galvanic Ring; H. N. Rowell, Boston, Mass., Assignor of one-half to John W. Duxbury, of same place. Application filed April 5, 1887. Two rings of metal, one positive and the other negative, are separated by some insulating material and the whole inclosed in a band.

371,523. Amalgamator; J. A. Sperry, of Brooklyn, N. Y.



371,336. MEANS FOR SUPPORTING OVERHEAD CONDUCTORS.

Assignor to C. A. Stevens, of Woodsburg, and Frank Sperry, of New York, N. Y. Application filed Nov. 18, 1886. A current of electricity is used to prevent the mercury from "flowering."

371,524. Induction Coil; E. Smith, Peoria, Ill., Assignor of one-half to F. Kimble, of same place. Application filed July 1, 1887. A portable battery provided with means for cutting off current at will, in combination with an induction coil arranged with a device for making and breaking the circuit as rapidly as required. See illustration.

371,531. Method of Operating with Electrical Conductors; J. E. Watson, Louisville, Ky., Assignor to the International Electrical Company, of same place. Application filed April 11, 1887. The principle of this invention involves the use of a weak current to oppose and limit the magnetizing influence of a closed local circuit and thereby hamper the magnetism, acting upon an armature at a distance from the magnetic pole.

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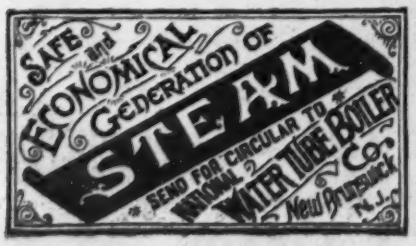

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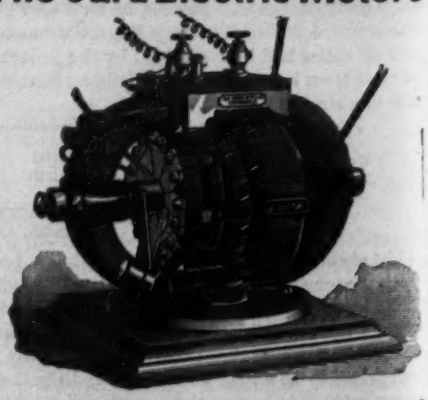

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